The Small Computer Magazine

kilobaud T.M.

Understandable for beginners . . . interesting for experts

October 1978 / Issue #22 / $2.00 / DM 8 / Sfr 8 / Ffr 18 / Sweden Kr 21 / UK £2

40K Bytes RAM Memory
1,200,000 Bytes Disk Storage
Desk with laminated plastic surface
DOS and BASIC with random and sequential files
TERMINAL—Upper-Lower case and full control character decoding

SWTPC

SOUTHWEST TECHNICAL PRODUCTS CORPORATION
219 W. RHAPSODY
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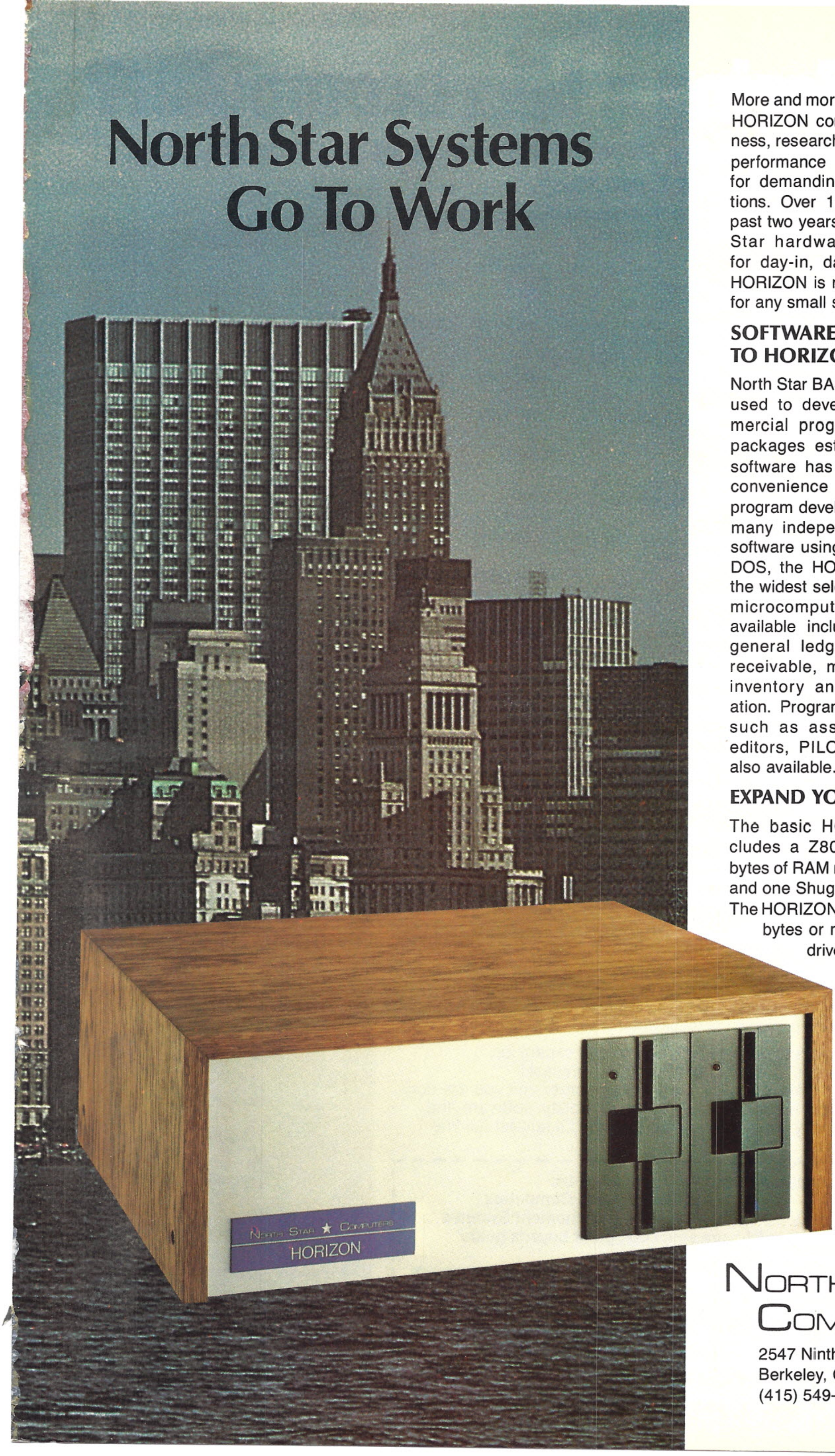
North Star Systems Go To Work



More and more, you see the North Star HORIZON computer at work: in business, research, and education. Its high performance qualifies the HORIZON for demanding professional applications. Over 10,000 users during the past two years have proven that North Star hardware has the reliability for day-in, day-out computing. The HORIZON is now a serious candidate for any small system installation.

SOFTWARE IS THE KEY TO HORIZON MATURITY

North Star BASIC and DOS have been used to develop hundreds of commercial program packages. These packages establish that North Star software has the completeness and convenience necessary for serious program development. Because of the many independent vendors offering software using North Star BASIC and DOS, the HORIZON owner now has the widest selection of software in the microcomputer industry! Software available includes: word processing, general ledger, accounts payable/ receivable, mailing list processing, inventory and income tax preparation. Program development systems such as assemblers, debuggers, editors, PILOT and FORTRAN are also available.

EXPAND YOUR HORIZON

The basic HORIZON computer includes a Z80 microprocessor, 16K bytes of RAM memory, an I/O interface and one Shugart minifloppy disk drive. The HORIZON can be expanded to 60K bytes or more of RAM, three disk drives, and three I/O interfaces. Performance can be enhanced by the addition of the North Star hardware floating point board. Also, S-100 bus products from other manufacturers may be used to expand the HORIZON.

For more information, contact your local computer store.

NORTH ★ STAR COMPUTERS

2547 Ninth Street
Berkeley, California 94720
(415) 549-0858

The C3-S1
by Ohio Scientific

Possibly the world's most popular floppy disk based microcomputer.

Since its introduction in August, 1977, the Challenger III has gained tremendous acceptance in small business, educational and industrial development applications. Thousands of C3-S1's have been delivered and today hundreds of C3-S1 demonstrator units are set up at computer retailers around the country.

Why has the Challenger III become so successful in the fiercely competitive microcomputer industry? Here are just a few of the possible reasons.

- The Challenger III is the fastest microcomputer in BASIC (see "BASIC Timing Comparisons," *Kilobaud,* October, 1977, where Ohio Scientific out benchmarks all competitors).
- The Challenger III is the only computer system with a 6502A, 6800 and Z-80 offering the programmer all popular micros for maximum versatility.
- The C3 is backed by the largest base of systems level software for any microcomputer system including:

  For the 6502A:
  - Microsoft 6 and 9 Digit BASIC
  - Assembler Editor
  - Word Processor
  - OS-65D Development DOS
  - OS-65U End User DOS with Extended BASIC
    - For Floppys
    - Winchester Hard Disks
    - Multi-users (Level 2)
    - Distributed Processing (Level 3)

  For the 6800:
  - Floppy DOS
  - Assembler Editor

  For the Z-80:
  - Floppy DOS
  - Microsoft Disk Extended BASIC
  - Microsoft FORTRAN
  - Microsoft COBOL
  - Macro Assembler and Editor
  - And Much More
- The C3 supports OS-65U, the ultra high performance "virtual data memory" DOS for floppys and hard disks which makes complex file structures like multi-key ISAM easy to use.
- The C3 is backed by a large library of applications programs and can make use of the tremendous amount of BASIC programs offered by independent suppliers and publishers because it uses Microsoft BASIC, the standard of the industry. Complete turnkey and custom business packages are available for the C3 from most OHIO SCIENTIFIC DEALERS.
- The C3 electronics and software are available in alternate mechanical configurations for special applications including the C3-OEM for volume users and the C3 letter series (C3-A, C3-B) which are optimized for use with hard disks.
- C3 systems are always delivered ready to use with 32K static RAM, dual floppys for 500K bytes of on-line storage and an RS-232 port strappable from 75 to 19,200 baud all *standard* in the minimum configuration.
- C3 systems offer the greatest expansion capability in the microcomputer industry. The C3 series supports OHIO SCIENTIFIC'S full line of over 40 expansion accessories. The maximum configuration is 768K bytes RAM, four 74 million byte Winchester hard disks (CD-74), 16 communications ports, real time clock, line printer, Word Processing printer and numerous control interfaces.
- C3 systems have phenomenal performance-to-cost ratios. The C3-S1 base price with 32K RAM, dual floppys, RS-232 port complete with 8K BASIC and DOS is under $3600 and expansion accessories are comparably priced. For example, the CD-74, 74 million byte Winchester disk complete with interface and OS-65U operating system at about $6000.

The C3 series is quite possibly so successful because it offers the highest hardware performance, best software support, most versatility and greatest expandability in the microcomputer systems market at nearly the lowest price in the industry.

For more information, contact your local OHIO SCIENTIFIC DEALER or the factory at (216) 562-3101.

OHIO SCIENTIFIC
1333 S. Chillicothe Road • Aurora, Ohio 44202

PUBLISHER'S REMARKS

Wayne Green

Report from Europe

The two recent European shows have done a lot to generate more interest in microcomputers in Europe. Most important was the Sybex-organized Micro-Expo in the U.S. Trade Center in Paris May 23-25th. This exposition was packed with interested hobbyists and computer professionals for all three days. The presence of Wayne Green and *Kilobaud* Marketing Vice-President Sherry Smythe helped give this show a truly international flavor.

The second show was in Geneva June 20-22nd and brought in over 7000 visitors to see about 100 booths of Swiss, German, French, English and American exhibitors.

The big show this fall is Electronika in Munich from November 9th to 15th; over 90,000 are expected to attend. *Kilobaud*-Europe, in conjunction with the ABC Computer Workshop of Munich, is organizing an Industrial and Personal Computer Expo '78 (IPE-78) in conjunction with Electronika, to be held in the Pschorr-Festaal building by the main entrance of Electronika.

Interest in microcomputers is growing rapidly in Europe, with about 50 shops specializing in them so far. (The first computer shop was Digitronics in Hamburg, started in February 1976, dealing in kits and S-100 systems.) You can find *Kilobaud* for sale in these shops in most major cities. The larger microcomputer stores are located in Helsinki, Uppsala, Stockholm, Malmo, Hamburg, Amsterdam, Bonn, Darmstadt, Munich, Geneva, Zurich, London and Paris. In Paris we have the first department store, Galeries Lafayette, selling microcomputer kits.

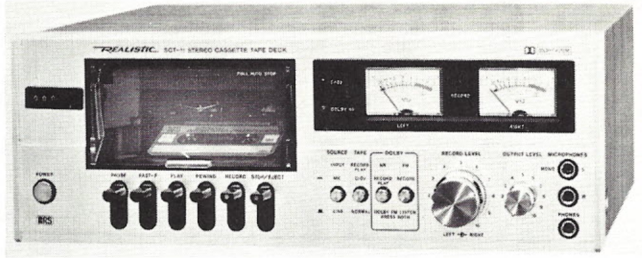
There are about ten computer clubs in Europe so far, and two microcomputer magazines: *Personal Computer World* from London and *Micomp*, a Swiss magazine (in German) that has developed an RCA 1802-based system called Micro-Macky for their readers.

Now, if only 10 percent of those 90,000 attending Electronika become converts to microcomputers . . . ?

Reinhard Nedela
***Kilobaud*—Europe**

It's Deck Time

A recent Radio Shack flier featured what has to be one of the better cassette deck bargains of recent times. The sale price on their SCT-11 stereo Dolby deck was $160 vs the regular price of $240, which was quite reasonable.



Radio Shack SCT-11.

In recent months Radio Shack has been making a major effort to change its image. The TRS-80 has been a major part of this change, bringing the public a first-rate computer system at a bargain price.

I don't know what the folks at Radio Shack think of their change in terms of class, but a rereading of Vance Packard's books could help put things into perspective. Packard broke the population of the U.S. down into three major classes and then divided each of those classes into three parts. He showed that many factors, such as clothes, cars, foods, entertainment, clubs, education, vacations, homes, furnishings, speech, etc., separate these classes.

Although no single person can be expected to fit a stereotype, the general categories do fit well. Take CB, for instance. Interest in this, particularly as far as using it for making extended contacts or building up elaborate stations is concerned, has been almost entirely a lower-class phenomenon. Middle-class CBers tend to use it for more emergency purposes than rag chewing. There is little sign that the upper class has had any interest in it at all.

Amateur radio, on the other hand, is more centered in the middle class, but you do occasionally hear upper-class people actively hamming . . . as well as some lower class. The microcomputer hobby has been almost entirely a middle-class interest. The educational demands for success in microcomputing are beyond most people in the lower class, as are the financial requirements.

In the past, Radio Shack has aimed many of its products at the tastes and interests of the lower classes. For instance, for some reason 8-track stereo systems have been more attractive to kids and the lower classes, while cassette systems have been more of interest to middle-class people and the more sophisticated children.

Many of the newer Radio Shack products are obviously aimed at the middle class. Whether this will drive away some of their large following in the lower classes or just add more of the middle-class customers is to be seen. It probably will turn out to be a good long-range move.

Anyway, getting back to the SCT-11, I've had one for some time now and have recommended it for ham use for recording slow-scan TV signals, RTTY and other ham shack uses. It also has obvious uses for saving computer programs. Look at it this way—why be at the mercy of a crummy cassette recorder that may or may not save a program in perfect shape? If you invest in a good cassette system you can use it for music, voice recording *and* computer programs.

If you can find an SCT-11, it will give you a front-loading cassette system that includes Dolby for either your tapes or for decoding FM broadcasts. The Dolby function may help you get better high-frequency response on some inexpensive cassettes, making the perfect saving of programs easier and cutting your cassette costs.

Kit Karnage

Perhaps you've wondered why George Morrow charges more for

There are about 50 computer stores in Europe so far. Here we see an exhibit of the new Imsai ADP-80 system by one of those stores. Though no Altairs were seen, one of the stores was showing the Apple. The Radio Shack TRS-80 is being assembled in Belgium and the PET is being built in Germany.

One of the most popular exhibits at the show was the new British microcomputer by NASCOM. This Z-80 system is generating a lot of interest throughout Europe, where it has Common Market advantages over U.S. products.

That's me pointing to the copies of Kilobaud. *London's Byte shop should have a better set of back issues available . . . back issues are like a continuing encyclopedia of microcomputing.*

a memory board kit than for the same board assembled and tested. A recent letter to Bill Godbout from an irate customer complaining about his boards not working, accompanied by a return letter from the test crew at Godbout, might clarify things.

The irate customer ranted because the boards wouldn't work. He returned two boards he had assembled and one he had partly assembled, with notice that he had stopped payment on his check. The Godbout lab members checked out the boards, turned around four 2102s put in upside down, took the 14-pin 74LS00 out of the 16-pin 2102 socket (can you *believe* that?), finished assembly of the third board, checked all of 'em out at 4 MHz and returned the boards to the customer with a note explaining that it is illegal to stop payment on a personal check . . . please send a new check.

Before you go writing angry letters to manufacturers, for heaven's sake, check out your work. Frankly, I just don't see how Heath has managed to stay sane all these years. I know they have to deal with this kit karnage all the time. They must be gluttons for punishment.

The Software Vacuum

One of the rules of thumb mentioned by macrocomputer and minicomputer salesmen is that application software for a system can be expected to cost about as much as the hardware. A recent study of macrocomputer software costs revealed that the average cost was about nine times the hardware costs.

Looking at minicomputer application software we see that the amount of work involved in writing the programs is not much different from writing programs for microcomputers. This would indicate that the cost of writing the programs would be similar. Estimates for software development for our Prime, a minicomputer, were in the ball park of $50,000. We've spent considerably more, and the programming is far from done, as any subscriber who has had problems with us recently can testify. We now estimate that the programming which we were aiming for when we bought the Prime will cost well over $100,000.

Good application software takes time, talent and dedication. All of these ingredients translate into money. So far there have been very few microcomputer buyers who have considered paying a software house $50,000 to develop software packages to make their systems work. It seems unlikely that this will change. The issue #14 of *Electronic Design* magazine pointed out that few buyers of $1000 computers seem interested in paying five or six figures for software.

Can the Bubble Burst?

With the buying of microcomputer systems growing month by month, the type of buyer has been changing considerably. The early buyers of microcomputers were avowed hobbyists who managed to put up with incredible delays for equipment which then didn't work . . . and never mind the lack of even a language program so they could write their own application programs. To the hobbyist the fun was in learning more than in the use. There are a limited number of this breed, which is why hobby computing has taken such a nose dive in the last year.

Most of today's buyers expect some substance to the long list of things a person is supposed to be able to do with a computer. When they spend $600 to $988 for a system, they really expect to be able to do more than play blackjack. The recent article in *Money* magazine is a fair hint of what is in store for the industry when people start discovering that there are virtually no usable programs for small systems.

It is unfortunate that editors these days find more readers for bad news than for good; so you can be sure that the *Money* article is only a hint of what can come. Once editors find out that they can run a cover story on the microcomputer fraud, you can be sure that you'll be seeing 'em in the *Enquirer* right on up to *Fortune*.

Such an attack by the magazines could not only slow sales of microcomputers, it could virtually stop them. This would close down most of the manufacturers and dealers and make it ten times as difficult for the industry to ever get started again.

The obvious solution is to get some software into circulation and to do it fast. But where are we going to get those five-figure programs we need? My answer to this should come as no surprise by this time: mass distribution of software with royalties going to the authors.

The old system of having software houses hire computer programmers to write applications programs was OK when there were individual customers willing to pay the $50 thou. It may turn out that there will be new systems houses which hire in-house programmers to write software for bulk sale. In the interim, my scheme of publishing and distributing programs written by freelance programmers seems the fastest way to get software distributed . . . before the bubble bursts and sales of hardware slow down.

CB manufacturers and dealers can testify as to how fickle the public is. CB is as valuable today

(continued on page 24)

kilobaud™

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LEGAL/ BUSINESS FORUM

Kenneth S. Widelitz
Attorney-at-Law

Trademarks

In thumbing through this and other microcomputer magazines, you have undoubtedly noticed virtually every advertisement contains some symbol or word which appears in conjunction with an R in a circle or the letters TM. Everyone knows that TM stands for the word "trademark." Everyone also has a vague notion of what a trademark is and the protection it affords. In this Forum I hope to make that notion a little less vague.

As defined by the Lanham Act, which was enacted by Congress in 1947, a trademark includes "any word, name, symbol, or device, or any combination thereof adopted and used by a manufacturer or merchant to identify his goods and distinguish them from those manufactured or sold by others."

The notion that the function of a trademark is to identify one seller's goods and to distinguish them from goods sold by others is widely held and is totally accurate. But an effective trademark does more than that. It signifies that all goods bearing the trademark come from a single source.

Theoretically, the trademark also signifies that all goods bearing that trademark are of an equal level of quality. Furthermore, the trademark is often the prime instrumentality used in advertising and in the sale of goods to create and maintain a demand for a product. As Justice Frankfurter once wrote, "Protection of a trademark is the Law's recognition of the psychological function of symbols."

A Property Right

The right to use a trademark is generally considered to be a property right in much the same manner that a patent or a copyright is considered to be a property right. However, whereas patent or copyright rights have economic value insofar as they tend to protect against the misappropriation or copying of a physical asset, the trademark's economic value is in the nature of an intangible asset, that is, goodwill. In other words, the word, name or symbol that becomes the trademark has no value unto itself except insofar as it represents to the consumer a specific product or service.

Another distinction made between patents and copyrights as opposed to trademarks is that rights in a trademark are acquired only by use of the mark, and the use must ordinarily continue if the right so acquired is to be preserved. On the other hand, a patent on an invention and a copyright on a literary work may be obtained even if not one working model of the invention or one copy of the literary work is sold.

Furthermore, in order to register the trademark under the Lanham Act, the trademark must be used in commerce that may lawfully be regulated by Congress—for example, interstate commerce. If a trademark is used only in intrastate commerce, it may not be registered with the U.S. Patent and Trademark Office. In such circumstances the only registration possible is in the state where the intrastate commerce takes place. Virtually every state has a registration procedure for trademarks that parallels the federal procedure. Of course, when state rules conflict with federal rules, the federal law prevails.

Some Definitions

There are a number of terms of art that are used in the trademark area. I will run over them very quickly. If you are interested in exploring this subject in any greater depth, take a look at J. Thomas McCarthy's treatise on "Trademarks and Unfair Competition," published by Lawyers Cooperative Publishing Co., Rochester NY, copyright 1973.

Two pamphlets published by the federal government might also be of some use. They are "General Information Concerning Trademarks" and volume 37 of the Code of Federal Regulations, which discusses patents, trademarks and copyrights. Both are available from the Government Printing Office.

First of all, it must be recognized that there is a difference between a trademark and a *service mark*. A trademark identifies tangible goods. A service mark is a mark used in the sale or advertising of services to identify the services of one person and distinguish them from the services of others.

Also to be distinguished is the term *certification mark*. That term means the mark was used upon or in connection with the products or services of one or more persons other than the owner of the mark to certify regional or other origins, material, mode of manufacture, quality, accuracy or other characteristics of such goods or services, or that the work or labor on the goods or services was performed by members of a union or other organization.

The actual words or symbols that comprise the trademark are categorized as fanciful marks, arbitrary marks or descriptive marks. A fanciful mark is a word coined for the express purpose of functioning as a trademark. It could be a made-up word or an obscure or archaic term not familiar to buyers. Examples of fanciful marks are "Clorox" to describe a bleach or "Polaroid" to describe optical devices and cameras.

An arbitrary mark is a word or symbol in common usage, but which is arbitrarily applied to the goods or services in question in such a way that it is not descriptive or suggestive. For instance, the term "V-8" is used to describe a mixture of eight vegetable juices. Another example is "Ivory" soap. Certainly there is no ivory in the soap.

A descriptive mark is just that —the words or symbols in the trademark are descriptive of the intended purpose or use of the goods, the size of the goods or of desirable characteristics of the goods. For instance, the words "Blue Ribbon" or "Gold Medal" describe desirable characteristics of goods and are therefore descriptive marks.

In order to obtain the benefit of trademark protection, a descriptive mark must have acquired a secondary meaning. When a particular business has used words for so long or so exclusively, or when it has promoted its products to such an extent that the words do not register their literal meaning on the public mind but are instantly associated with one enterprise, such words have obtained a secondary meaning.

A fanciful mark does not need any proof of a secondary meaning, while a descriptive mark must have a secondary meaning. If you are trying to decide between a few suggested trademarks, all other things being equal, you will make your life easier if you choose a fanciful mark over a descriptive mark.

Trying to prove that words in a trademark are associated "in the public mind" not with the words' literal meaning but with one enterprise can be difficult. While it has been suggested that consumer acceptance of such words can occur virtually overnight, the courts generally speak in terms of years.

Another term of art that arises in trademark situations is what is referred to as a "generic term." A generic term is the name of the product or service itself and is the antithesis of a trademark. For example, the term "Thermos" has been deemed by the courts to be a generic name regardless of the fact that the product is actually a vacuum-insulated bottle. Thus, the word "Thermos" can no longer serve as a trademark, although it was originally introduced as such. Because "Thermos" has become a generic name, it has been placed in the public domain and can no longer be protected.

In order to prove that a trademark challenged as being a generic term has significance as a trademark, it must be proven that the primary significance of the term in the mind of the consuming public is not in the product but rather in the producer of the product. If the primary significance in the mind of the consuming public is that words describe a product, then the words have become generic. However, if the words bring to the mind of the consuming public that the goods are produced by a specific manufacturer, the trademark has served its purpose in the classic trademark sense and is not a generic usage.

One more note on the words in the trademark itself. In order to be able to use a personal name in a trademark, the personal name must have acquired a secondary meaning. Take the example of

Smiths' Cough Drops. When two Smiths had begun to sell cough drops, there would be no secondary meaning.

However, when there is but one Smith, and when through advertising and sales the term "Smiths'" acquires consumer recognition, then a new cough-drop maker, even though he is named Smith, cannot use his own name. The ability to prevent someone from using his own name is a very hot issue and has been the subject of much litigation.

It should also be noted that a trademark cannot be registered if it consists of immoral, deceptive or scandalous matter, or matter that may falsely suggest a connection with persons, living or dead, institutions or beliefs. A trademark cannot consist of a flag or coat of arms of the United States or any state or municipality or any foreign nation.

A trademark also cannot be registered if it consists of a name, portrait or signature identifying a particular individual except by his written consent. And, of course, no registration is available if the proposed trademark consists of a mark that so closely resembles a mark previously registered that it would be likely to cause confusion in consumers' minds.

Application for Registration

The Patent and Trademark Office will provide you with application forms for registering your trademark. The owner of the mark, whether it be you as an individual, a partnership or a corporation, may file and prosecute his own application, or he may be represented by an attorney or other person authorized to practice in trademark cases.

The written application is concise. In addition to requesting your name and address, it requires a statement that you have adopted and are actually using the trademark shown in a drawing that must accompany the application. You must specify the particular goods on which the mark is used and the class of merchandise it falls into according to the official classification. There is a classification that includes scientific and electrical apparatus and calculating machines, among other things. It seems to be the most applicable classification to computer-related products and services.

The application also requests the date of the first use of the mark. In addition to the written application, you must provide a drawing of the mark in pen and ink and five specimens or facsimiles of the tag, label or other form in which the mark is actually applied to the goods. Last, there is the $35 filing fee.

A few weeks after the application is filed, the Patent and Trademark Office will send a notice indicating approximately how long it will take before the application is reviewed and acted upon. You can count on its taking about six months between filing the application and registration.

Notice of Registration

The mere registration of the trademark is constructive notice of your claim of trademark on the particular mark or word registered. No further notice is necessary in order to gain the right to prohibit others from using your trademark by obtaining an injunction against that use.

However, in order to recover damages for infringement there must be a formal notice of registration displayed in conjunction with the trademark. Either an R in a circle or the words "Registered in U.S. Patent and Trademark Office" or "Reg. U.S. Pat. & Tm. Off." may be used. Note that those notice designations may only be used once the trademark is registered. They may not be used merely because an application has been filed.

Often you will see TM used in conjunction with what appears to be a trademark. Although the letters TM have no formal meaning, McCarthy, in his treatise mentioned above, suggests that there are four possible purposes that the use of the letters TM serve. (1) To educate the public regarding the trademark use of a descriptive or suggestive word or slogan. (2) Those letters may serve as a no-trespassing sign to ward off competitors. (3) It is possible that the display of those letters may be used as evidence in applying for registration or in an infringement action. (4) The use of the TM may be to prevent a word from being adopted by customers in a "generic" sense rather than a trademark sense.

As always, keep in mind that this discussion has been a vast oversimplification of only part of the area of law involved in trademarks. If you are actually in a situation where you will be filing an application for a trademark, you should consult an attorney.

Legal/Business Forum
c/o Kenneth S. Widelitz
10960 Wilshire Blvd.
Suite 1504
Los Angeles CA 90024

KB CLUB CALENDAR

Steve Fuller

Annandale VA

The National Capitol Chapter of the Tandy Computer Users Group meets here on the last Wednesday of each month and is open to all interested persons. For details on the group's activities, write to Rod Wright, 8205 Chivalry Road, Annandale VA 22003, or call (703) 560-5854.

Johannesburg, South Africa

The Transvaal Amateur Computer Club was founded in 1977 and now has 120 members. The club meets on the first Wednesday of the month at the Senate House of the Witwatersrand University.

If you'd like to exchange information with the Transvaal Club, send a copy of your group's newsletter to them at PO Box 6639, Johannesburg, South Africa.

New York City

Ms. Abby Gelles is president of the New York Amateur Computer Club. Meetings are held on the second Thursday of each month at Bernard Baruch College, 17 Lexington Avenue (corner 23rd St.), Room 903 at 7 PM. Information is available by writing to PO Box 106, Church St. Station, New York NY 10007.

Psychiatry/Psychology

MICRO-PSI is a bimonthly newsletter for those interested in computer applications in the field of mental health. It contains articles about clinical applications and research, office uses and privacy, micros and minis, book reviews and a column for bringing together readers who share a common interest.

The subscription rate is $10 per year from MICRO-PSI, Box K, 26 Trumbull St., New Haven CT 06511.

PROSE Users Group

The programming language PROSE "was designed for those wishing to solve calculus-level numerical problems in engineering, management science, business, physics, operations research, chemistry, biology, medicine, etc., without having to supply solution methods," according to a recent announcement from Users Group spokesman Frank Pfeiffer.

"Currently, CDC or Univac versions of PROSE are available to the public . . . IBM versions will become available in August 1978 either as an RJE service or license basis for in-house use."

Those persons wishing to receive and/or contribute to the PROSE newsletter or communicate with the group should contact Mr. Pfeiffer at Bechtel Power Corporation, 12400 East Imperial Highway, Norwalk CA 90650.

Valparaiso IN

The first Tuesday of the month at 7:30 PM is the meeting date of the Valpo Tech Microcomputer Society. The club meets in Hershman Hall on the Valpo Tech campus.

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BOOKS BOOKS BOOKS BOOKS

How To Profit From Your Personal Computer: Professional, Business and Home Applications
T. G. Lewis
Hayden Book Company, Inc.
Rochelle Park NJ
$7.95, paperback, 208 pages

The title of Mr. Lewis's book is a guaranteed attention-getter, but could be a little misleading. This is not a book about how to go into the computer business. The author is too realistic for that. Instead, he assumes that the reader is already in some other business and can profit from the use of microcomputers. His aim, stated explicitly in the preface, is to help the reader "learn how to configure a system to fit the needs of an application." This is certainly an admirable goal, and the author does a pretty fair job of achieving it.

The book begins with a brief discussion of hardware. This discussion is general and largely unnecessary since the book is pitched to a nontechnical user. With that out of the way, the author introduces the first of several fictitious small businessmen, the proprietors of Tom Swift's Motorcycle Shop, and follows these characters through recognition of their problem (in this case inventory control), the decision to use personal computers as a solution, the sizing and selection of the hardware system and the selection and implementation of software. This case-history type of illustration is used throughout the book with progressively more complex applications and progressively greater emphasis on software.

In fact, the emphasis on software is one of the best things about Mr. Lewis's book. Both in his case studies and in explicit statements, he makes the point that software is the critical and troublesome part of any application. Hardware is relatively cheap, readily available and more or less standardized. Software is expensive, troublesome, costly to develop and far from standardized. The selection of software presents the unwary user with a bewildering variety of options and alternatives—with countless opportunities to make the wrong choice.

The author works out his case studies in reasonably thorough detail and in prose that is much more lucid and engaging than is the average in computer books. The examples cover a range of business applications from accounts receivable to a full-blown banking system and, in the process, give the reader an in-depth look at some generally useful computer techniques, such as sorting.

However (there's always a however), not every part of these case studies is equally well done. The problem analysis and formulation of solutions is uniformly excellent, clear and easy to follow. The implementation of the solution is less clear. The author plunges into the details of programming with very little explanation of the functions performed by individual instructions. As a result, the programming examples are harder to follow than the other parts of the case histories. The information is there, but considerably more digging is required of the reader.

The small businessman should also beware of the author's one apparent blind spot. In considering the computer service options available to the small businessman, Mr. Lewis discusses timesharing, batch processing on large machines and personal computing. He does not discuss the small-scale, stand-alone business machines available from a number of old-line manufacturers and several new companies. Although these are probably more expensive than a personal computer, there are advantages to the maintenance and software support available from a big-time computer company.

Even in his discussion of "smart terminals" for a savings and loan office application, there is no clue to the reader that any number of companies are turning such devices out by the hundreds. This may be a case of technology overtaking the literature, or he may have dismissed such devices as too expensive and beyond the scope of his book. For whatever reason, this seems a serious omission from the list of options available to the small-business user.

That objection aside, Mr. Lewis's book is useful reading for the small businessman contemplating a computer, or for the personal-computer advocate contemplating a business application. Either one can gain from this book a more realistic view of the problems and possibilities inherent in the business use of personal computers.

A. H. McDonough
El Segundo CA

6800 Programming for Logic Design
Adam Osborne
Osborne and Associates, Inc.
PO Box 2036, Berkeley CA
300 pages, $7.50

If you have in mind doing serious design with the 6800, this book is an excellent starting place. It is a tool to be used by those interested in implementing hardware logic design in microprocessor software form—primarily people involved in designing dedicated controller micro systems. Unlike most small reference books, the table of contents is unusually comprehensive, and I have found that most helpful.

The book is printed in two types. Boldface type allows you to skim read until you get to the area you are looking for, and then in lightface type you will find expanded detailed information. The book is a sequel to *An Introduction to Microcomputers* and assumes you have read it or are familiar with the basics.

The approach of showing us "how to do it" is concise and starts with an example of simulating a digital logic signal inverter by describing the microprocessor event sequence, implementing the transfer function, determining data sources and destinations and event timing. This detail is included for buffers, amplifiers, gates, flip-flops and other 74XX logic. At this point, each digital logic function could be implemented in software if you had to do it, and an example is given for a printer interface.

Chapter three does exactly this in great detail. This is where the learning and transition from old world to new takes place as the reader, by this time, is saying to himself, "There must be an easier way to do it," and there is. The author does not recommend this procedure and proceeds to demonstrate by writing an assembly program looking at the total transfer function using the input/output signals. As you might expect, this reduces the size of the program. However, the author does not stop here. As those of you who are programmers know, there are many ways to do the same thing; so the next chapter is devoted to looking at reducing the number of program steps. Many tips on reducing program size are provided, and, of course, no complete reference would be without a description of the MC 6800 instruction set.

For the logic designer the last chapter, a collection of commonly used subroutines, will pay for buying the book. Subroutine categories covered are: memory addressing, data movement, arithmetic and program execution sequence logic. The "Notes" section at the end, two blank pages, was not sufficient—but then, some people don't write in books as I do, anyway.

If you plan to use, or are using, the MC 6800, this is an excellent reference book for the beginner.

Stu Mitchell
Woodbridge VA

The Way To Play
Bantam Books
666 Fifth Ave., NYC 10019
$7.95, paperback

If you have ever wanted to write a game program, but you were not sure about the rules of the game, or you just wanted to write a game program but you couldn't think of a good game, then *The Way To Play* resolves the dilemma. Its 320 large, easy-to-read pages contain the complete rules for over 2000 games from Accordion to Zignette. It also contains over 5000 original drawings and diagrams in color to illustrate the rules.

The table of contents conveniently lists the games by "type," such as strategic board games, dice games, solitaire games, etc. In addition to the table of contents, a handy index in the back lists each game in alphabetical order. In cases where a game is known by more than one name—checkers or draughts, for example—the index lists the game under each name.

Not only are the general rules for each game listed, but in most cases several variations of play are included. Casino games such

as blackjack, roulette, etc., also contain gambling rules and odds as found not only in American casinos, but the different variations found in European casinos. Every detail of play needed to correctly program a game can usually be found.

Game playing is still very popular with microcomputerists, and newcomers may think all they have to do is sit down at the terminal and bang out a good game program. It is impossible to correctly program a computer to play a game when all the rules are not known and understood. *The Way To Play* eliminates this problem and paves the way to hours of fun programming and playing just about any game ever invented. That's what makes it one of the most important reference books in my library.

Chuck Stuart
Dallas TX 75227

The BASIC Workbook
Kenneth E. Schoman, Jr.
Hayden Book Co., Inc.
Rochelle Park NJ, $4.25

The BASIC Workbook is not a textbook that will teach you all about BASIC. It is a student workbook, designed to be used with a regular series of lectures. It covers only a fundamental subset of BASIC statements, which are probably universal to most BASIC interpreters, and covers them very well indeed. Once a student has learned these statements, he will be able to write almost any BASIC program and should be able to learn any other BASIC statements on his own with no difficulty.

The BASIC Workbook consists of ten chapters and three appendices. The chapters deal with computers and problem solving, elementary statements, the art of programming, loops, functions, arrays, I/O, strings, developing larger programs and simulation. Appendix A is a "cheat sheet" showing all the BASIC statements used in the book. Appendix B tells how to correct mistakes at the terminal and briefly mentions debugging. Appendix C gives three programs to plot graphs on a standard terminal. Finally, there is a comprehensive index.

Since the workbook assumes that the student has attended a lecture, it does not go into great detail about any of the BASIC statements. The text of each chapter contains a summary of the BASIC statements covered, a sample statement and a sample program using the statement. There are over 40 sample programs in the workbook, ranging from a three-line program to assign a value to a variable and then print the variable, to a program that simulates the waiting time of customers at an auto-repair shop.

Except for chapter one, the text of each chapter is followed by a set of suggested problems. Each problem is a program that the student is to write. Most have notes giving any mathematical formulas needed, suggested test data or other comments about the types of input you should allow for, or methods to use for the solution. Each problem is on a separate page, with a large blank area in which the student may take notes. There are over 60 of these problems in the workbook. They are well chosen, both to test the student's skill with the various BASIC statements and for their usefulness. Problems include sorting, searching and merging routines, math routines, games and a stock-market simulation!

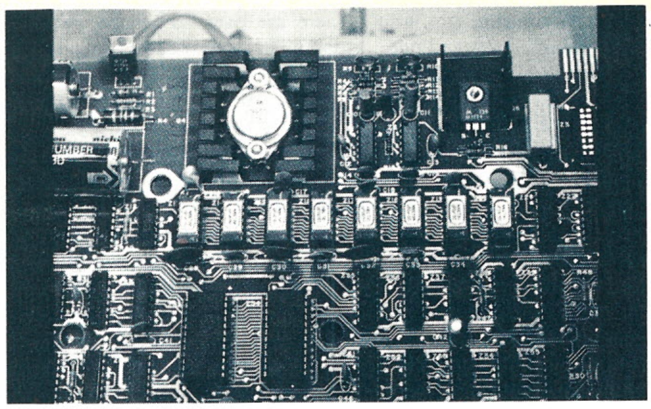
I have only one complaint with the workbook: Of ten chapters, only one is devoted to strings, and this contains only two pages of text and doesn't mention many of the common string functions. For example, there is no mention of Mits BASIC RIGHT$, LEFT$ or MID$ functions. The ability to handle strings is one of the features that makes a computer more than an overgrown calculator, and I think it deserves more space than it was given. In defense of the workbook, I must say that this minimal treatment of strings is common to most of the teaching materials on BASIC.

In all, I think *The BASIC Workbook* has filled a gap in the teaching of BASIC. A student already familiar with programming in other languages can probably learn BASIC quite speedily from the workbook, without the need for lectures. With the workbook, such a student will not have to waste time sifting through lengthy discussions on how to program in order to learn the statements of the BASIC language, but can read the summaries and be writing BASIC programs in a short time. The rank beginner, on the other hand, will need some sort of lecture or additional instruction. For him, the workbook will be a very good set of class notes, which are even indexed! This will free the student to concentrate on the lecturer in class. I certainly plan to use *The BASIC Workbook* in the next class I teach!

Glen Charnock
Oxnard CA

NEW PRODUCTS

Edited by Dennis Brisson



Godbout 16K RAMs installed.

Machine Language Monitor and game of LIFE for TRS-80, Level I

LIFE, originated by John Conway, is one of the most popular demonstration programs for small systems owners. LIFE by Small System Software, Box 483, Newbury Park CA 91320, is ideal for store and home demos. The universe consists of a 48 × 128 cell rectangle, which scrolls off the top and bottom, left and right to the other side of the screen. One generation takes approximately one to two seconds (very fast considering the universe size—6144 cells).

Included with the program are several patterns which can be read from or saved on cassette tape. The photo shows a pattern of "gliders" and a "glider-eater"—excellent for a perpetual demonstration in the shop or at home. Overall I found the LIFE program to be among the best I've ever seen and the best I've seen function on a 4K system.

I rank the Machine Language Monitor as "good." It can perform ASCII, hex and machine-language dumps. You can load, write, modify (the searching routine came in very handy when it came to modifying) and execute machine-language programs. You can also write, read and verify machine-language programs on cassette tape. There are well over 20 different commands as well as an interrupt built into the monitor. As machine-language monitors go, it's "good" . . . however, for a 4K machine, it is actually an excellent monitor.

Both programs are available from Small System Software: LIFE (RSL-1) is $14.95; monitor Intermediate (RSM-1) 2K is $17.95, and a more advanced version (which wasn't made available to *Kilobaud*), 4K of memory (RSM-1S), is $23.95.

Edward C. Dow, Jr.
Kilobaud **Staff**

Game of LIFE display from Small Systems Software.

TRS-80 16K Conversion Kit

Godbout Electronics has long been involved with memory products and accessories. Their latest addition is a 16K update kit for the TRS-80. We ordered ours on a Thursday morning and within 48 hours had it in our hot little hands. The kit consists of: (8) 16K dynamic RAM chips (manufactured by NEC), (2) 8-position DIP shunts and, of course, four pages of installation instructions, which have diagrams and pictures, which help if you are unfamiliar with hardware.

After you read the instructions and proceed to install the kit, the entire process takes no more than 15 or 20 minutes (that is, if you have never done this before!). Relatively little is involved with the installation . . . you merely unplug the old 4K dynamic RAM chips (which you can save if you ever want to convert your machine back to a 4K) and plug in the new 16K dynamic RAMs. After that, you just unplug the two DIP shunts and plug in the new unprogrammed ones. Then you must "program" the DIP shunts according to what revision TRS-80 you have (there are two, REV A and REV D).

We had no problems here. This programming step tells the TRS-80 hardware the amount of memory in the system (address selection). Now you must reassemble the TRS-80 and test out the new memory.

In summary, the Godbout conversion kit is very well documented; it worked the first time we installed it and has worked ever since. Price is $190. If you don't mind doing 15 to 20 minutes of work (and learning something about your TRS-80's hardware at the same time!), then this kit is for you. Oh yes, I forgot to mention that you will also save $100. Available from: Bill Godbout Electronics, Oakland Airport CA 94614.

Mitchell Wolrich
Kilobaud **Staff**

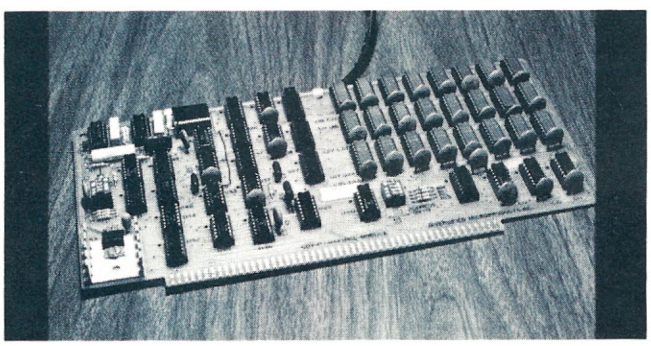
GDT-0 Graphics Display Module

The GDT-0 Graphics Module plugs into any open S-100 bus connector and provides the user with a 192 (vertical) × 128 (horizontal) bit-map display. The board uses 3K of onboard memory (128*192 = 24,576 bits or 3K bytes), which is completely addressable and, therefore, can be used for program memory as well as display memory.

The board is capable of inverse video as well as the standard white dots on a black display. The display is sharp, crisp and clear. The software that comes with the board is useful; it shows 3-dimensional views of cities, airports, etc. GDT-0 is easy to write programs for, and can be used easily with, BASIC as well as machine-language programs. All in all, the board is a good value for a medium resolution graphics display.

The GDT-0 Module is available for $235 from Diversified Micro Products Corporation, 56 Sicker Rd., Latham NY 12110.

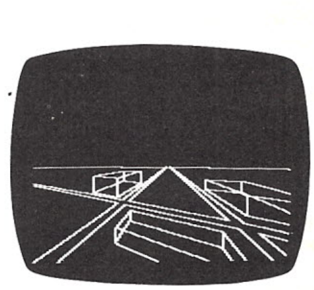
Mitchell Wolrich
Kilobaud **Staff**



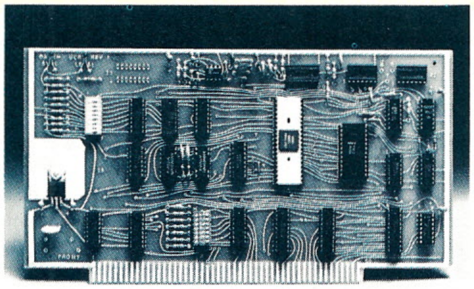
GDT-0 graphics module.

540 Video Display

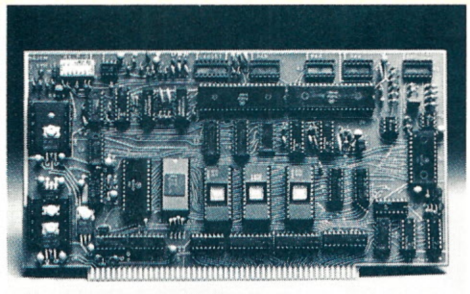
The 540 Video Display, Ohio Scientific's video display interface from its Challenger IIP, is being offered as a fully assembled accessory for any OSI system and has also been incorporated in the company's mainframe class personal computer, the C2-8P, and in two floppy-disk-based computer systems. The 540 Video Display features a 32 row by 64 column display of the standard 64 character ASCII font in 5 x 7 dot matrix form. Standard features include programmable formatting of the display for 32 x 32 or 32 x 64. The 32 x 32 mode is useful for video animation since it provides square character cells.



Sample DMP graphics.



Universal Cassette Recorder Interface.



System Central Interface.

The video board features a keyboard port, which can be used with a standard ASCII keyboard or OSI's new programmable keyboard. The 540 also optionally supports a graphics character generator, which features lowercase and about 170 special characters for plotting and gaming.

All systems using the 540 incorporate Ohio Scientific's new 542 programmed keyboard. It is a fully programmable keyboard system, which is capable of upper and lowercase and auto repeat on all characters. The keyboard also features up to five levels of shifting to allow many special single keystroke commands and direct single keystroke graphics. The keyboard has provisions for character editing and supports special formats for video games.

The Model 540 Video Board is available as an add-on option for any existing OSI system as a CA-11 and retails for $249. The graphics character generator option retails for $29.

Ohio Scientific, 1333 South Chillicothe Rd., Aurora OH 44202.

Teletek's UCRI and SCI Interfaces

The Universal Cassette Recorder Interface (UCRI) is an S-100 compatible board which uses biphase recording for high speed and reliability. Speeds are switch-selectable from 600 to 40,000 baud and are controlled by the system clock for stability. This board also features a keyboard input port and onboard relays for cassette control. The user-selectable sync character allows biphase (Tarbell), CUTS, Kansas City and other sync-character formats. This interface, with a keyboard and a video interface, comprises a minimal cost system with complete I/O and mass storage capabilities.

The System Central Interface, or SCI, designed for use with the S-100, provides a serial port with RS-232 and 20 mA or 60 mA current loop capabilities and speeds from 45 to 9600 baud, three independent 8-bit parallel ports which can be programmed bitwise for input of latched output, a high-speed cassette port capable of reading and writing biphase (Tarbell), CUTS and Kansas City with data speeds from 800 to 100,000 baud, two on-board relays for control of two recorders, three status lines to control an automatic tape deck, 256 bytes of RAM for stack space and buffer storage, a 2708 programmer, two 2708s with a 2K system monitor program and space for an additional 2708.

Teletek Enterprises, Inc., Dept. 36, 11505B Douglas Rd., Rancho Cordova CA 95670.

RS-16-H Universal Interface

A single RS-16-H, requiring one parallel I/O port, can be used to control many different peripheral devices as directed by a microcomputer. The device provides all electronics needed to drive 16 outputs (relays, motors, lamps, solenoids) and sense 16 to 24 inputs (TTL or switch contacts, including magnetic reed switches), with all inputs and outputs brought to a 44-pin edge connector. If the interface ever fails, a special diagnostic connector can be substituted. Failed ICs can then be found and replaced using the diagnostic BASIC program provided, without need for factory repair.

Each output line can be individually set or cleared using BASIC, machine code or other language by means of I/O read or write commands. A special command (or the manual reset button) can be used to clear all outputs simultaneously. If desired, simple switches can be wired to allow manual override of the computer's commands.

Sixteen external status conditions can be selectively sensed by condition number. Eight of these inputs sense levels (e.g., fixed switch positions), and the other eight sense either levels or pulses (e.g., reed switches passing a magnet or fast light pulses detected by a photocell).

Since all peripheral device inputs and outputs pass through an edge connector, electric trains, stereos, burglar alarms or other devices can be wired to individual connectors, and the RS-16-H can be plugged into any one of these.

The unit is completely assembled and tested with case, sample BASIC programs and installation manual at $229. The installation manual alone is $5 and can be applied toward purchase for 90 days.

Cooper Computing, PO Box 16082, Clayton MO 63105.

Three New MicroPrinters from Axiom

Three new line printers from Axiom include the EX-801P, which has a parallel ASCII input, priced at $395; EX-801S, priced at $495, has an RS232/20 mA serial input to 1200 bps, which covers most data communication requirements; and the EX-801H, priced at $549, for users who need serial input to 9600 bps.

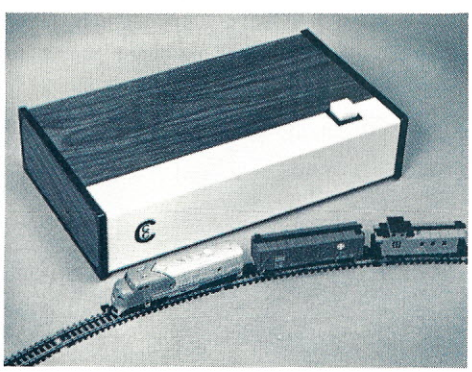
The EX-801 series of MicroPrinters operate up to 160 characters per second, offering users the choice of three character sizes to provide 80, 40 or 20 columns on the five-inch wide electrosensitive paper. Designed around the Intel 8048 microprocessor, the EX-801 printers provide: 256 character multi-line asynchronous input buffer, expandable to 2000 characters, which permits a CRT page dump in one second; 96 character ASCII, expandable to 256 characters with user programmable fonts; 2K bytes of user programmable ROM, which converts the EX-801 into a truly intelligent printer.

Each EX-801 model is a complete stand-alone printer including case, power supply, parallel and/or serial interface, character generator, low paper detector, bell, built-in self tester and paper roll holder. The MicroPrinters are compact, standing 11 inches wide, 4½ inches high and 12 inches deep. Weight is only 12 pounds, including a 230 foot roll of paper.

Axiom Corporation, 5932 San Fernando Road, Glendale CA 91201.

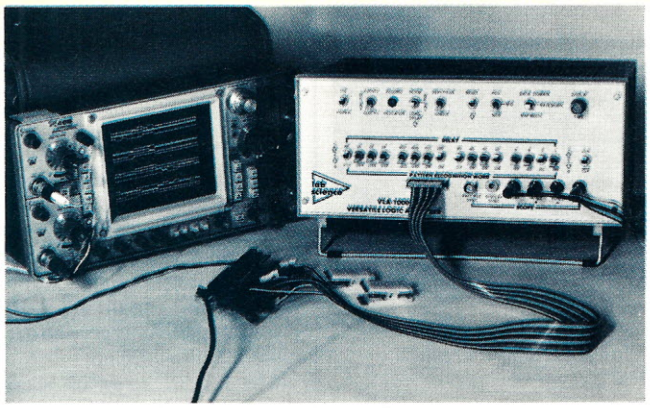
Logic Analyzer Oscilloscope Accessory

Lab Science, PO Box 1972, Boulder CO 80306, announces



RS-16-H Interface and peripheral.

Axiom's EX-801 line printer.



The VLA 1000 Versatile Logic Analyzer.

the VLA-1000 Versatile Logic Analyzer that displays 16 bits by 16 words in Data Domain, Waveshape, Map Mode and Dual Byte D/A modes in sharp detail on any oscilloscope with an external horizontal input. By diverting the display to the side of the screen when recording, no oscilloscope blanking connection is required. The 16 input data plus clock lines are fully buffered and compatible with all standard logic families.

Other features include: dc to 10 MHz, synchronous or asynchronous, repetitive, or single-shot operation; 0-9999 event or clock delay; positive-, mid- or negative-time display; dual byte, real time D/A conversion or Map Mode available on front-panel jacks; choice of both plus and minus horizontal 'scope outputs on front panel to accommodate 'scopes with either polarity external horizontal drive; end-for-end data word inversion by reversing front-panel input data connector.

The unit is packaged in a metal enclosure, 6 × 12 × 8 inches with tilt stand. The 41-page operating manual includes timing diagrams and clock qualification schematics for all popular microprocessor families, plus detailed operating instructions and troubleshooting guide. Price is $575.

16K RAM Fully Static Memory

Electronic Control Technology's 16K RAM memory board is a fully static 16K S-100 bus memory board which utilizes a 4K fully static memory IC (TMS-4044) like the 21L02, except that it has four times the capacity per IC package and less power per bit.

Being fully static eliminates incompatibility with DMA devices or other devices, which sometimes occurs with dynamic or clocked static memory. All signals to MOS devices are buffered by low-power TTL to prevent damage by static electricity and to minimize capacitive loading on the bus. Low-profile IC sockets are provided for all ICs.

The board has solder mask and a silk-screened legend. Two MHz operation is standard, and 4 MHz is optional at a slightly higher price. The board kit is $350.

Electronic Control Technology, 763 Ramsey Ave., Hillside NJ 07205.

KISS—File Control System

A Keyed Indexed Sequential Search (KISS) System developed by Tascon Corporation enables multi-key access to a user's disk files. KISS provides user-selected variability of key and data lengths. The file control system includes an Indexed Sequential File Manager (ISFM) and a Direct Access File Manager (DAFM).

The system is implemented in assembler language to assure core and processing efficiency. The absolute maximum number of disk accesses to retrieve any record under control of KISS is three. KISS is designed to operate on the 8080/8085 and Z-80 based systems.

Depending on key and data length and user buffer space allocated, KISS produces record search and retrieval operations that are several orders of magnitude faster than currently available file methods. KISS is distributed as a relocatable object module on user specified formatted floppy disk. Currently, configurations are available for Imsai (DOS-A) and ISIS-II using PL/M, FORTRAN, assembler and Extended BASIC.

The three-section, illustrated User Guide that includes technical concept, user interface control and actual file control code examples for various languages is included in the price of $485, or can be acquired separately for $22.50 plus $2.50 for postage and handling.

Morrow Computer and Electronic Design, Inc., 315 Wilhagan Rd., Nashville TN 37217.

Imsai Introduces New Dynamic RAM

RAM III, a new line of dynamic random access memory boards developed by Imsai Manufacturing Corporation, is available in 32K or 64K versions. Specifically designed for inclusion in Imsai's line of VDP desktop computers, the boards are also available for add-on to already existing systems. The 32K version retails at $895 and the 64K version retails at $1695. RAM III boards are S-100 bus compatible and do not make already existing Imsai RAM boards obsolete.

A "Hidden Refresh" (during a normal CPU operation, the refresh synchronizes to CPU timing so that refresh takes place when the CPU is not using memory) means *no wait states* are required. During operations that take place when the CPU is not running, such as direct memory access (DMA), an internal timer generates refresh requests every 6.6 microseconds. A high-precision delay line generates on-board timing for high performance and reliability. All of the RAM III boards have an access time of 375 nanoseconds and a cycle time of 500 nanoseconds.

Power requirements are low: +8 volts dc at 360 mA, +16 volts dc at 250 mA and −16 volts dc at 10 mA. The total board dissipates only seven Watts. Address decoding is provided for 20 address lines plus four alternate address lines. All address selection is implemented by a simple-to-use DIP switch.

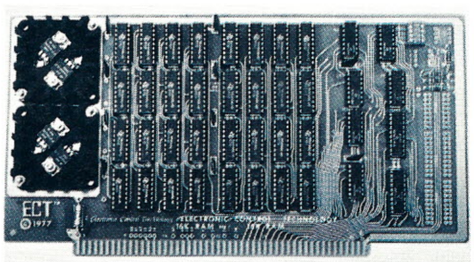
Imsai Manufacturing Corp., 14860 Wicks Blvd., San Leandro CA 94577.

TC-3 Cassette Interface Board

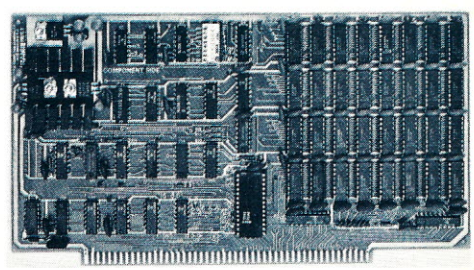
The new TC-3 Cassette Interface Board provides high-performance program storage for SWTP computer systems. The interface board plugs into one I/O slot of the SWTP motherboard, eliminating the inconvenience of a separate cabinet. Connection is made to a standard cassette recorder through two audio cables.

Speed and data reliability in the TC-3 are comparable to that of minifloppy disks. The interface operates at 4800 baud and loads a 4K file in eight seconds. Data is recorded in a modified FM format similar to disk systems. Applications include use as the primary mass storage device for SWTP computers that are presently using much slower paper tape or "Kansas City" cassette recording and as high-speed back-up storage on disk-based systems.

The TC-3 also provides a fully buffered 8-bit output port capable of directly sinking 40 mA at 30 volts. The port has full handshake and interrupt capability for use as a parallel data port or as discrete output lines to control the cassette recorder. Available as a complete kit including plated-through board, all components, instructions and complete software source



ECT's memory board.



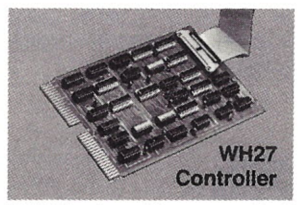
RAM III board.

Heathkit Personal Computers are "System Designed"– Read about them in the FREE! HEATHKIT CATALOG

*Complete descriptions of the best in personal computers – now available in kit **and** assembled versions*

In the world of personal computing, compatibility of design and operation is an important consideration. The computer hobbyist or small business user of today doesn't have time to iron out hardware and software problems that can arise from a "shotgun" approach to system design.

Heathkit Personal Computer Systems are just that – systems. They were designed around each other for total complementary performance. Expansion within the computer itself and with our peripheral devices is always a trouble-free transition.


WH27 Controller

You can start with our low-cost 8-bit H8 Computer and just 4K of memory as an introduction to computing. Its easy to use octal data entry and 9-digit octal readout make learning a simple matter. As your abilities grow, so can your computer. Add more memory and one or more peripherals like the H9 Video Terminal with its ASCII keyboard for convenient entry and display of your programs. And you can store your programs in one of three ways too! Choose our new WH17 Floppy Disk System (single and dual drives available) for the ultimate storage mode. Its expanded 40-track hard sectored diskette has 102K Bytes of available storage so you can store hundreds of programs on one disk. If paper tape storage is your preference, choose our H10 Paper Tape Reader/Punch. For the most in economy, we offer a cassette player/recorder too. The H8 is indeed a complete system.

Send for your FREE copy today!

Or bring this coupon to your nearby Heathkit Electronic Center (Units of Schlumberger Products Corporation) where Heathkit products are displayed, sold and serviced.

Heath Co., Dept. 351-460, Benton Harbor, MI 49022

The ultimate personal computer is our 16-bit H11. Very few people will ever need more computing power than our H11 has to offer. Based on the world-famous DEC® PDP-11/03, it has enough capability for virtually any program – small business or hobby. The H11 offers unequalled software, too, so the number of useful applications is virtually unlimited. The H11 will soon have its own Floppy Disk System, the WH27. And what a floppy it is! Fully-compatible with the DEC RX01® floppy for the PDP-11/03, the WH27 lets you take advantage of all existing PDP-11/03 software in addition to those you develop on your own. Dual drives give you 512K Bytes of program and data storage. The WH27's Z80 microprocessor-based controller permits a head motion of only 6 mS (versus DEC's 10 mS) for data access times that are almost twice as fast. Other features include built-in self test on power-up; mechanical interlock to prevent disk damage; write protect function that precludes written-over disks; complete HT11 disk operating system software that includes extended BASIC with files and virtual arrays, utilities (with macro-assembler), text editor and more. An extended FORTRAN which supports the ANSI standard (1966 FORTRAN IV) will be optionally available soon.

Read more about Heath system-designed computers and other outstanding kits (nearly 400 in all) in the latest Heathkit Catalog. It's FREE.

Specifications subject to change without notice.

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Schlumberger

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Heath Company, Dept. 351-460
Benton Harbor, Michigan 49022

Please send me my FREE Heathkit Catalog.
I am not on your mailing list.

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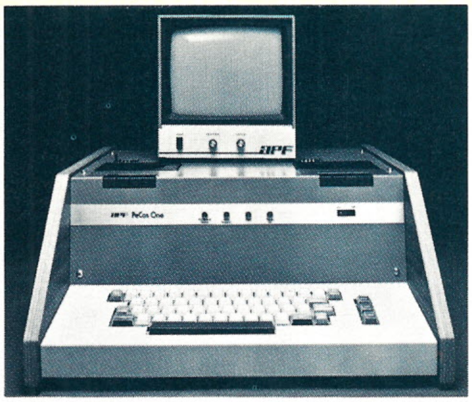
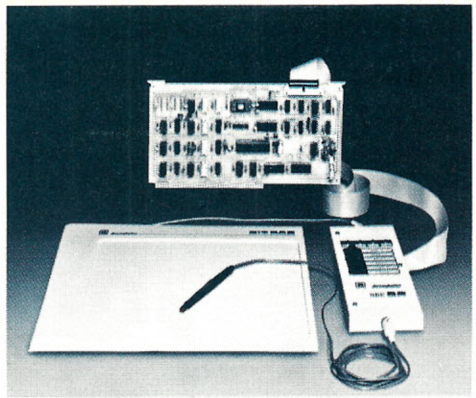


APF's PeCos I.



New Bit Pad configuration.

listings. Price is $49.95.

JPC Products Company, PO Box 5615, Albuquerque NM 87185.

PeCos I Personal Computing System

PeCos I incorporates comprehensive math capabilities, large memory and ease of programming in realistic English-like computer language. PeCos I (PErsonal COmputing System) is a fully integrated computing system. It combines a 9-inch CRT, a standard size 60-key keyboard and dual cassette decks.

The easy-to-learn PeCos language makes it possible for almost anyone to use the computer without lengthy training. PeCos language is a derivative of the JOSS language developed by Rand Corporation; users have found that PeCos language is much easier to learn and program than BASIC.

PeCos I has a math program that permits full computation in nine-digit floating decimal arithmetic with a number range from 1×10^{-99} to 1×10^{99}. PeCos I has built in all the functions of a programmable calculator—including trigonometry, number dissection, string concatenation, transcendental and the ability to define functions.

PeCos I also has 24K ROM and 16K RAM internal. It has unique built-in dual cassette decks that are semi-automatically controlled. The cassette decks use standard audio cassettes which can each store up to 80K bytes of information. It is possible to read from one tape and write to the other. All of PeCos I's I/Os are done at a baud rate of 800 speed tolerant recording, one of the fastest speeds possible in the personal computing field.

The unit measures 18½ × 19½ × 8½ inches and also includes digital tape counters for rapid data retrieval, tape files addressable by either name or number and two optional cassette decks to further expand the system. PeCos I requires no hook-up with RF adapters, TVs or audio cassettes or other peripherals. The self-contained system is all that is needed to be up and running in the home, office, laboratory or school. Everything required to operate is standard. Price is $1695.

APF Electronics, Inc., 444 Madison Avenue, New York NY 10022.

Multibus/Bit Pad System

A new version of Summagraphics Bit Pad, the digitizer for small computer systems, is now Intel Multibus-compatible. The Bit Pad can now be plugged into the Multibus along with Single Board Computers (SBC), memory and I/O boards, peripherals and controllers.

All electronics are located on one SBC card. Operational control and status indication is provided from a small, hand-held console. The system also includes an 11-inch × 11-inch Bit Pad tablet and a date input stylus. The basic Multibus/Bit Pad configuration carries a retail price of $625.

Summagraphics Corporation, 35 Brentwood Ave., Fairfield CT 06430.

Computer in a Suitcase

R2E of America, the North American subsidiary of Réalisations études électroniques, the French microcomputer manufacturer, announces a new, complete, portable microcomputer system, small enough that CPU, printer, display and minifloppy drive all fit in a supplied 22 × 14 × 7 inch suitcase, yet powerful enough to run Business Applications Oriented BASIC (BAL) and FORTRAN.

The Micral V weighs only 40 pounds and is available to run on 12 or 24 V dc or on standard 120 V ac. The Micral V can be used as a stand-alone system or a remote terminal.

Hardware consists of an 8080-type CPU, 32K of RAM (expandable to 64K), 1K of EPROM, a 480-character alphanumeric display panel, a keyboard with 13-key numeric pad, single-density minifloppy drive (providing 80K bytes of storage) with double density optional, a 32-character-per-line alphanumeric printer, a Centronics printer interface and power supply. Hardware options include a second minifloppy disk drive and a serial communications channel.

The retail price for the Micral V is $7995.

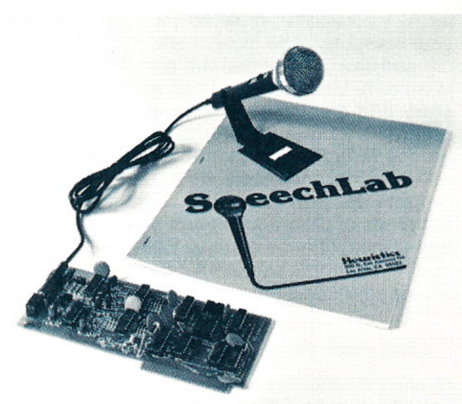
R2E of America, 306 University Ave., Minneapolis MN 55414.

Voice Input for Apple II

Speechlab Model 20A, a new voice data input unit for the Apple II, has been announced by Heuristics, Inc., 900 N. San Antonio Rd., Los Altos CA 94022. The system, available at computer stores and directly from the manufacturer for $189, assembled and tested, includes a high-fidelity microphone and a user manual with six demonstration programs written in Apple BASIC.

The unit complies with the Apple II peripheral conventions and interfaces directly with user written BASIC programs as easily as keyboard input. The program to run the unit is contained on an on-board PROM, which is automatically enabled and executed by the Apple II monitor program when speech input is desired, allowing speech input to be easily incorporated into the user's present and future programs. Speechlab Model 20A features a 32-word vocabulary, fast real-time response and the capability

R2E's Micral V.



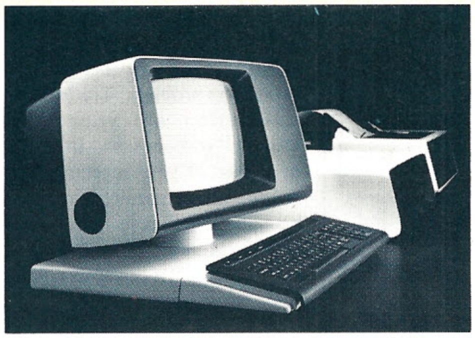
Heuristics' Speechlab.

of multiple training samples for high accuracy. An optional headset mounted noise-cancelling close-speaking microphone for use in highly noisy environments or for applications requiring free use of both hands is available for $85.

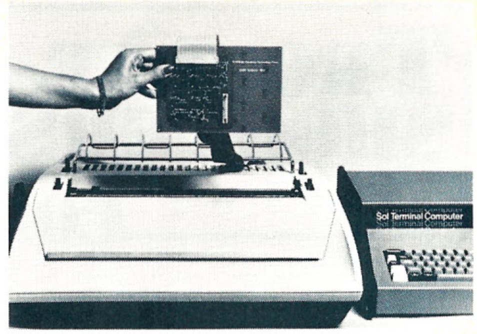
Adam the Younger

Logical Machine Corporation, 1294 Hammerwood Ave., Sunnyvale CA 94086, has introduced Adam the Younger, a new computer system for small businesses. The new system employs the same natural-language logic as the company's larger Adam system.

Ease of operation and a comfortable price brings full computer power into the practical reach of small systems users. Adam the Younger requires no software or computer languages. First-time users may teach existing business routines to Adam the Younger in everyday English. The complete desk-top system—consisting of a microprocessor-based CPU, keyboard, twin floppy-disk storage module and a versatile report printer—retails at $14,995 and can be leased for about $350 per month.



Lomac's new Adam computer.



Hytype I & II printer interfaces for Sol computer.

PRS Software

PRS—The Program Of The Month Corporation—was recently established to meet the growing demand on the part of microcomputer users for well-documented software. PRS offers software with extended documentation, which gives clear, complete and instructive text in a graphically appealing manual. The documentation not only provides step-by-step instructions, but also is geared to help the end user understand hardware/software interactions and promote further applications. PRS attempts to incorporate "human engineering" designing in their code, whether it be for games, applications (home and business) or sophisticated programming tools and monitors.

PRS software presently includes "Microfile," a data file management program and "DDS II," the dynamic debugging system. Software is packaged in a gold-stamped cassette folder. New programs will be released at regular intervals. Major brands supported include: Sol, Apple, TRS-80, Sorcerer and other systems with Z-80, 8080 and 6502 processors.

PRS-The Program Of the Month Corporation, 257 Central Park West, New York NY 10024.

Sample software package from PRS.

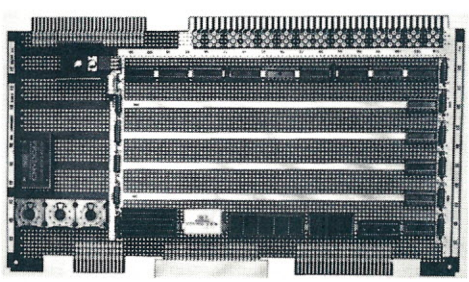
VE Prototyping Boards

Two new prototyping boards, form- and size-compatible with either Intel SBC 80/10 and SBC 80/20 or National BLC-80/10, BLC-80/11, BLC-80/12 and BLC-80/14 microcomputer boards, have five double-sided card-edge connectors for convenient bus-oriented, parallel or serial input/output. Available from Vector Electronic Company, 12460 Gladstone Ave., Sylmar CA 91342, as models 4608 and 4608-1, the 12-inch by 6.75-inch by 0.042-inch boards are pre-punched with 0.042-inch diameter holes on 0.1-inch grids. They accommodate DIPs with 0.3-inch, 0.4-inch, 0.6-inch and 0.9-inch lead spacing as well as other components such as solid-state relays, electromechanical relays and thumbwheel switches.

The 4608 model has power and ground buses to reduce wiring labor and improve performance on custom interface boards. Pad arrays, surrounding three-hole groups, permit soldering DIPs and interconnections or easy solder mounting of wrap-post DIP sockets. Board intraconnections are made with wrapped wire or solder. The Model 4608 holds up to 54 16-pin DIPs in the patterned area and also has a 13-square-inch unclad area for total freedom in component placement.

Vector's Model 4608-1 is identical to the Model 4608 in size and edge connectors, but it has no etched pattern. It holds up to 144 16-pin DIPs.

Fabricated of blue, FR-4 epoxy glass composite material, the boards are clad with two-ounce, 0.0028-inch-thick copper conductors. Power buses are solder plated for easy termination while the card-edge connectors are gold flashed, nickel plated for long life and low resistance. The 4608 boards are priced at $45 in 1 to 4 quantities, and the 4608-1 boards are priced at $34 in 1 to 4 quantities.



4608 Prototyping Board.

New Printer Interfaces Announced

Two new printer interfaces for increased hard-copy capability of the Sol computer have been announced by Processor Technology Corporation. Sol Hytype I mounts inside any Diablo Series 1200 Printer connecting it directly to the back of the Sol. Similarly, the Sol Hytype II Printer Interface works with the Diablo Series 1300 Printer. The installation package includes the fully assembled, tested and burned-in printed circuit board, software, all cables and mounting hardware. No modification to the Sol is necessary; no holes need be drilled in the printer . . . the printer can be restored to its original condition if required.

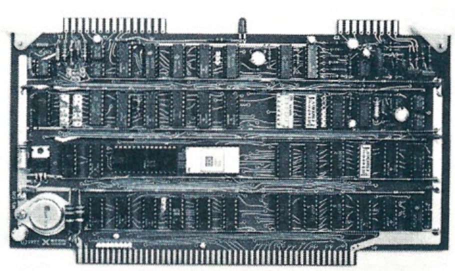
Hytype driver software is included on CUTS cassette along with a source listing. The user may modify the driver software to suit a particular application. Suggested retail price for both the Hytype I and Hytype II is $150.

Processor Technology Corporation, 7100 Johnson Industrial Drive, Pleasanton CA 94566.

SMART Cassette-I/O Controller

The MS-CIO is a fully integrated audio-cassette serial-I/O controller unit with a built-in relocatable operating system. This device supports two cassette/tape units and any data terminal/printer capable of communicating via either an RS-232 or 20 mA current loop interface.

(continued on page 24)



The MS-CIO.

TROUBLE-SHOOTERS' CORNER

Ralph Wells

Some Fundamentals of Defining the Problem—Using Substitution Techniques

One of the problems Jim Fox posed in *Kilobaud* #19, p. 9, was "How do you troubleshoot a dead system?" If your system is dead, then no one can tell you specifically what to do to fix it. I will try, however, to delineate some fundamental guidelines to help you *learn to fix it yourself.*

If you can use your assets (first step) to really define the problem (second step), then fixing it (third step) is usually the easiest. The second Troubleshooters' Corner (August 1978) emphasized the first step, namely, *take stock of your assets.* This time, we'll use Jim's query as a springboard to deal with the second step— defining the problem.

The September column referred to the use of two basic methods for defining the problem: *signal tracing* and *substitution.* In practical situations, neither method is used to the exclusion of the other, and the speed with which a problem is solved is directly dependent upon the choice of techniques used. The line between them is very thin and gray indeed. This month we'll take a close look at *substitution* and leave the topic of signal tracing to a later column.

Synectic Solutions

In my second column, I introduced *synergistic synectics* as a troubleshooting concept. When it comes to defining a problem, synectics is a very powerful tool. "Synectic groups" are used by industrial psychologists for defining and coping with a wide variety of issues, ranging from psychotherapy to high-level management to think tanks, etc. Basically, it means the use of interactive (synergistic) problem-solving techniques to apply the *diverse backgrounds and disciplines* of a *group* of people to the solution of a problem or the formulation of a "breakthrough."

The application of synectics to your personal computing problems means that you can usually define and solve (debug) computer problems using methods you've learned in *other* fields. You can often gain an insight just by asking yourself the question, "If this were a problem in my field, how would I tackle it?" A "dead" computer is probably a hardware problem, so you might expect that an engineering degree would be a prerequisite for its solution . . . *not so!*

Adapt Your Background

There *is* one prerequisite for successful troubleshooting—*common sense.* If you have at least an average allotment of old-fashioned horse sense, then you can acquire the rest of whatever it takes to troubleshoot most (but not all) of the problems you're likely to encounter.

The methods you've been using to solve your everyday problems can almost certainly be used on your computer. For instance, the same basic principles are involved in troubleshooting a "dead" computer (using substitution techniques) and in fixing a flat tire by using your spare tire. Of course, if your car won't run because it is out of gas, then changing the tire won't help—you still need common sense.

One commonsense approach to defining problems in general is to "box" them in. By using general observations of what the problem *is* and (often more important) what it is *not*, you can set up dividing points, or walls. On one side of the wall, it works; on the other side, it either fails or is questionable.

By finding things that *do* work, you can set up walls around your problem. This is true for nearly any kind of problem, including hardware and software bugs. Inputs and outputs are the most obvious points to examine when first setting up the walls to *box in* your problem.

Edgar Allan Poe described a scene in which the walls of a room were slowly moved together, and we saw the same scenario in *Star Wars.* The protagonists escaped, but hopefully your bug won't. Defining the problem is accomplished by moving the walls in toward the problem. Tracing and substitution are your most powerful wall-movers. In either case, most of your ingenuity and energy will be required to move the walls together to box in your bug. If it weren't so frustrating, it could be fun. It's certainly a challenge.

Game Plans

If you've played some of the common microcomputer guessing games, such as "Guess a Number," "Hurkle" or "Chomp," then you're already aware of some effective game plans or strategies for logical troubleshooting. For instance, if you try to guess a number between two limits (walls), your best strategy is to try a number halfway between the limits. This will move one or the other of your "walls" the maximum amount. By continuing to divide the remainder by two on each trial, both the upper and lower limits can be moved together with the greatest efficiency.

Programmers will recognize this as the binary search used to search or sort a file. Housewives file recipes and secretaries file correspondence using the same approach. Although theory calls for splitting the problem in half, common sense should alter the strategy.

For instance, if you were to file the name AARIKA AARONS, you'd jump to the conclusion that it's probably very close to the beginning, and search accordingly. The object is to move your walls together as fast as possible, and, in practice, it's often easier to break up your problem at places that are not exactly halfway points.

Some Soft Wall-Movers

Using substitution to debug software or hardware involves the same general fundamentals; but software debugging comes closest to pure common sense, so we'll tackle it first. Let's say you've just loaded a program in BASIC and when you hit RUN, it bombs out: Everything goes dead. Sooner or later (usually sooner) it happens to all of us. Is it the program or is it the computer?

To set up the first wall, you could substitute a simple program that you know for certain has run OK. If it works, then the computer is probably OK and the problem is likely to be in the new software. We can move this wall of the box in toward the problem a little more if we try a very complex program of known validity. If it works, then you can have even greater confidence in your hardware and in a variety of I/O subroutines contained in the test program.

If you've been developing a program, then common sense will usually give you some clues as to the likelihood of hardware problems. If any changes have been made (in either hardware or software) since the last successful run, then these areas go to the top of the suspect list.

Let's assume that the hardware checks OK and the I/O drivers are functional. Now reload the program that bombed, only this time list it and use a very powerful software wall-mover, the END statement (software interrupt for a 6800 or 6502 machine-language program). Find some logical point in your BASIC program about halfway through and substitute the END statement, preceded by "PRINT END," for the first instruction of the next program sequence.

Now try running your program. If it doesn't bomb out, it will probably display "END" and you will have moved your input wall to the 50 yard line. If it bombs out, then you have probably moved your output wall to the same place, and your next step should be to try the same substitution at a point one-quarter of the way through. If that fails, try one-eighth, and so on, until something works.

If you're doing this in BASIC and you've left spare line numbers between statements, as good practice dictates, then it isn't necessary to substitute. A simple insertion between lines will suffice. If you're using machine language, then you'll probably have to substitute in order to avoid doing a re-compile for each test. In either case, don't forget to return your substitutions to normal!

When You Can't See the Forest—Blaze a Trail

Boy Scouts and Tom Sawyer learned early that a good way to keep from getting lost is to leave markers behind. A good wall-mover to use in debugging a BASIC program is to sprinkle a lot of PRINT statements throughout the trouble zone. When you run such a program, it leaves behind a trail (sometimes called an "audit" trail) of markers that can

often close in the walls of your box much faster than the binary search. This is a lot harder to do in machine language, but by substituting "jumps" for key instructions, the substituted code can be duplicated (along with a print command) as part of a temporary "patch."

The methods we've discussed will sometimes identify the bug right down to a line or subroutine that *should* work, but doesn't. This is a good place to try a "place-kicker" substitute that is *specialized* for only a single function, instead of the multifunction programming that usually causes this problem. It works like the parable that tells us when you can't break a bundle of sticks, try breaking them one at a time.

Some Hard Wall-Movers

In the last examples, we assumed that the hardware was OK and the bug was in the software; but when Jim Fox asked about a dead system, he was probably talking about a hardware bug. Now let's assume that the software is OK.

To start with, a system is seldom really dead unless a fuse is burned out; so if there's no pilot light, then the fuse is the first thing to be substituted. If the fuse blows again, *proceed with caution.* Visually check anything that was done to the computer since the last time it worked correctly.

Check for: mismatched plugs, solder splats and bridges, loose wire trimmings between IC legs, wire-wrap pulled tight around corners, burned or discolored resistors (or ICs), frayed insulation, bent legs on ICs or pins in sockets, deformed IC sockets, leaking electrolytics and anything else that just doesn't look right.

If the fuse holds, the pilot light should come on, indicating that the power supply is probably OK, and you've established one wall of your box. If the fuse blows again or the pilot light doesn't come on, then either you have an overload (probably shorted) or your supply has a bug.

Substitution Is Your Best Bet

Substitution and tracing are the two principle debugging tools for hardware, as well as software. Substitution is usually the fastest troubleshooting technique, and it also requires the least amount of specialized training.

It has two major drawbacks. The worst is that you must have something to substitute for the suspected defective part. For the hobbyist, this usually means that he had better find a friend with an identical microcomputer, as recommended in my earlier columns emphasizing synergistic synectics. Sooner or later the friend is probably going to need the same thing, so it's a two-way street.

Avoid Catastrophes

The second drawback is that whatever defect caused the original fault could blow out a substituted part. This tends to strain even the best of friendships, so every effort should be made to avoid catastrophic overloads.

Substitution techniques require a minimum of test equipment, but to prevent catastrophic failures, some method of measuring the dc power supply voltages is almost a minimum requirement. It doesn't have to be really high quality, just as long as it's capable of comparing the supply of a good computer with that of the defective one.

The important thing is to be certain that all supply voltages and input/output voltages (and/or currents) are correct before swapping boards or chips. Modern digital components are very forgiving of minor or short-term overloads; so if the power supply and I/O ports can pass the visual and dc checks, the chance of catastrophic failure is low enough for practical purposes.

Moving the Hard Walls

Moving the walls with hardware substitution is even more straightforward than with software. Except for single board computers such as the KIM and SC/MP, the various elements of today's computers are of modular construction. Debugging consists of swapping one circuit board at a time until the bug moves from one machine to the other. This can isolate the defective board, and if the ICs are socketed, then the same method can be used to isolate a defective chip.

In my experience, defective chips count for more than 70 percent of all defects, once the original wiring has been debugged. Broken wires, defective sockets and capacitors make up the bulk of the remainder.

To Socket or Not to Socket

There is a debate going on as to the relative merits of sockets for chips, and the picture is changing. The intermittent contacts that plagued the first IC sockets are getting rarer. On the other hand, the ICs are getting more reliable, so that there is less need to make replacement easy.

If I'm building a kit (which I do if at all possible), I always use sockets, even when I have to buy them as extras. If I ever have to change a chip, I'll install a socket even if the original was soldered in.

Socketed memory chips are a problem. The sockets become intermittent with the high impedance, low-current usage, but memory chips are at least ten times more prone to failures (and replacement problems) than any other devices. 90 percent of my problems with the PET have been with memory chips, and 60 percent of the current Sphere memory problems are intermittents in the sockets.

Memory is one place where you don't need a friend's computer to use substitution techniques; you can usually swap your own. You *will* need a memory test program, but they are readily available for nearly all machines, and several articles have been published if you want to write your own.

Will the Patient Live?

If your computer has sockets and you can swap with a similar machine, then I'd estimate that Jim Fox's dead computer would have an 80 to 90 percent chance of full recovery, using only a dc voltmeter and the substitution techniques I've outlined. Multiboard systems (like the S-100) are more amenable to swapping than TRS-80s, Apples, PETs or KIMs. Chip substitution may not identify the faulty component, but it can usually zoom in on a small enough area so that other methods, such as shotgunning, may become practical.

As the name implies, the "shotgun" method means that you simply replace everything associated with that particular circuit, without trying to analyze it. With chips in the two-bit bracket and test equipment in the thousands of dollars (to say nothing about trained technicians' time), it is often the cheapest solution, even for the hobbyist.

Of course, there are other methods of reviving an ailing computer when substitution fails, and we'll be taking them up in future issues. I would prefer to use your problems as illustrations of how they can be used.

Reader feedback is essential to the success of this column. If you have problems, questions, answers—anything relating to troubleshooting, send them to:

Troubleshooters' Corner
c/o Editor
Kilobaud Magazine
Peterborough NH 03458

Contest!

"Compatibility and the Altair Bus" by Bill Fuller was voted best article for the month of July. The winner of a book from the KB Book Nook is J.H. Wildermuth of San Diego CA. Congratulations to you both!

To be eligible for both this drawing and the drawing for the lifetime subscription to *Kilobaud*, all you have to do is write your vote for the best article of the month in the space provided on the reader-service card and mail it to *Kilobaud*. (The winner of the lifetime subscription is listed in Publisher's Remarks.)

LETTERS

Dear Manufacturer . . .

On February 28 I ordered a disk-based Z-80 system, which I have been hoping to use for the development of software for use by individual physicians, particularly those in academic environments. This was an assembled system, and I was promised that it would be delivered in six to eight weeks when I placed my order, and it was paid for promptly. It is now five months later, and I still do not have a working system.

Without going into full detail, which would be boring to you and depressing to me, I should like to outline some of my problems to you so that you may understand the depth of my dissatisfaction with the service I have received.

February 28—System ordered.
Two weeks later—Additional memory ordered (32K board in place of two 8K boards).
April 10—System delivered.

Thus far the delivery appears good. Unfortunately, on opening the delivery cartons, I found that the keyboard cabinet was cracked, as well as having the wrong logo. One disk drive was defective, with a noisy bearing, and the two 8K boards, instead of the 32K board that I requested six weeks previously, had been sent to me. I called immediately and spoke to your service representative, who was courteous and business-like and told me that if I shipped back the boards, the drive and the keyboard, he would ensure that I obtained immediate replacement with the correct equipment.

April 13—Boards returned.
April 13—Keyboard returned.
April 20—Disk drive returned.

After two or three weeks, nothing happened. I then started to make phone calls and received assurances from another company representative that the equipment would all be shipped "next week." After about six or eight phone calls and a total of two months, I still had received nothing.

I then received from you a delivery, which I opened to find the keyboard cabinet but with the wrong cutout, which simply did not fit my keyboard at all. This was useless and had to be returned, too.

After more phone calls, the same company representative promised me unequivocally that my 32K board would be mailed on June 12 (or nine weeks following your receiving my returned 8K boards).

Apparently the 32K board was mailed on June 12, but to the *wrong* person. (With, I admit, a similar name.) It was therefore several weeks later before the board finally reached me. There was a *three-month* delay between the time that I returned the 8K boards and the time that you sent my 32K board.

In the meantime, I received the disk cabinet, which had been shipped by UPS. This was heavily damaged, apparently by crushing in transport, and I have photographed the damage for the record. You will no doubt understand that I am unwilling to ship this cabinet back to you, as I must very regretfully conclude that I am better off with damaged or defective equipment, than I am returning it to you for replacement or repair.

It is now over three months since I returned to you the defective disk drive, the repair of which would take about 15 minutes. After many phone calls, speaking both to people in Customer Service and to your secretary (you are "in a meeting" whenever I call), I am told that "nothing can be done" and that your company can give me no expectation as to when I will get the drive back. I am told that it has been sent to the disk-drive manufacturer for repair and that you will ship it to me when they return it to you.

I must point out that I did not return the drive to this manufacturer nor did I pay them $4000 for this equipment. I ordered the drive from you, and I paid you for the equipment. I think that you have a responsibility to either insist on my getting better service from them or send me a new disk drive. It is now almost six months since I ordered and paid for my equipment, and it is still not functional. In addition to the delay and the frustration, I have been obliged to spend about $150 in shipping and telephone costs to try to resolve this problem.

It would obviously be of advantage to me to encourage colleagues who are interested in acquiring small computer systems to use the same hardware as I do, but I trust that you will understand that I cannot give your firm any recommendation whatsoever.

Peter R. Maggs, M.D.
Boston MA

Kudos to SWTP

In my opinion, Southwest Technical Products Corp. is entitled to a place on your list of honorable computer-products suppliers.

I sent SWTP the advertised price of $20 for a copy of their *Miniflex, Ver. 1., Advanced Programmer's Guide.* In about three weeks, I received the manual. Then, I received a note from SWTP informing me that the price of the programmer's manual had been reduced to $5. Enclosed with the note was SWTP's refund check for $15.

During the past year, I have complained about slow response to customers' orders. My respect for the quality of the company's product has never wavered.

I am impressed by the demonstration of integrity displayed by SWTP's officers who made the decision to refund money to which they were legally entitled.

That action has earned their company my respect and continued goodwill.

Sherman P. Wantz
Sebring FL

Incompatibility?

In the July 1978 issue of *Kilobaud* you published an article, "Compatibility and the Altair Bus," by Bill Fuller. In this article Mr. Fuller made the remark that CGRS Microtech, Inc., had redefined some of the basic pin functions of the Altair bus on the CGRS 6502 CPU board.

I don't know where Mr. Fuller got his information, but it is incorrect. Mr. Fuller does not own a CGRS Microtech microcomputer, nor does he know a thing about the compatibility or incompatibility of the CGRS 6502 CPU board on the S-100 bus.

For your Mr. Fuller's information, CGRS Microtech, Inc., manufactures a CPU board on the S-100 bus with the 6502 processor. We use control logic to simulate the 8080 signals. The card generates all the S-100 I/O control lines, but we do not duplicate the low-order address lines to the higher order when I/O takes place. All our signals are on the standard bus with no redefinitions at all. We manufacture a board called the TIM II I/O, which is also on the S-100 bus, that uses the 6530-004 MOS Technology chip for RS-232 or 20 mA Teletype serial I/O and high-speed paper-tape input. This board also contains a 6520 PIA for two 8-bit parallel ports. We have a DMA control panel that approaches a logic analyzer in function in the hands of an experienced user. We have just introduced a new board called "A Lot of I/O," which will contain 2 full serial RS-232 ports, four programmable parallel ports, a connector to adapt the Persci 1070 intelligent floppy-disk controller to the S-100 bus, plus a lot more. See our news release dated June 13, 1978. All of this can be packaged in our System 6000 mainframe—which we consider the nicest one on the market.

We have put a lot of time and effort into the design of the CGRS 6502 CPU board, and remarks like those by Mr. Fuller can be very damaging to our sales effort—because most people reading his article do not realize that he is a self-appointed expert who doesn't know what he is talking about. I hope this letter helps to clear up a lot of confusion Mr. Fuller may have created.

Joseph T. Swope, President
CGRS Microtech
Southampton PA

. . . More Comments . . .

In the article "Compatibility and the Altair Bus," July 1978 *Kilobaud*, Bill Fuller states, "The CGRS MPU, also listed, is not compatible due to redefinition of some of the basic pin functions." This is not true, and because he references an article that I wrote in July 1977, I would like to clear this up.

I own a CGRS 6502/S-100 MPU board. I have not noticed any redefinitions of pin functions on that board. The timing is 6502, but logic on the board simulates the 8080 signals. The card generates all the S-100 I/O control

lines; however, it does not duplicate the low-order address lines to the higher order when I/O takes place.

I have purchased S-100 peripheral cards from six different vendors with no problems. Mainly because I chose the cards from a *compatibility list* published by CGRS. I have found the 6502 to be very fast and powerful, and my experience with the S-100 bus has been excellent. I do recommend two sure methods to prevent incompatibility problems: (1) get a compatibility list from the CPU vendor and (2) buy from a *computer store* where you test first.

William Goble
Perkasie PA

. . . Reply

In researching the article "Compatibility and the Altair Bus" over 150 manufacturers were queried for undefined pin usage. Mr. Swope of CGRS Microtech responded to the request in a letter dated June 22, 1977. Enclosed with the letter was a copy of *Using the "Standard" Small Computer Bus Structure* by W. M. Goble. Also, referenced in the letter was an article, "Introducing the S-100: Standard Small Computer Bus Structure" (*Interface Age*, June 1977) by W. M. Goble. Thus, you see my main source for information on the CGRS bus usage.

In the above referenced enclosure the following pin "definitions" are provided: 4. NMI (VIO), 26. BUS AVAILABLE (PHLDA), 44. SYNC (SM1), 45. LOGIC 0 (SOUT), 46. LOGIC 0 (SINP), 74. HALT (PHOLD) and 76. LOGIC 1 (PSYNC). These are the main signals I based my comments on related to "redefinition" by CGRS.

An expert, "self-appointed" or otherwise, might recognize that some of the above signals are really not "redefinitions," if they perform essentially the same function as the bus-defined signal. For example, 44. SYNC (SM1) performs the function of indicating that the processor is in a fetch cycle for the first byte of an instruction. Rather, this is termed SYNC, or SM1 is not really important when it is clearly understood that the signals are equivalent. A more appropriate way of indicating this would have been: 44. SM1 (SYNC).

A case may be made that inactive signals such as SINP and SOUT equaling LOGIC 0 or PSYNC equaling LOGIC 1 are "redefinitions" of active signals. Also, NMI (non-maskable interrupt) on pin 4 (Vector Interrupt 0) technically might be considered as "redefined." Vectored interrupts are generally maskable and can be ignored by the processor when necessary; however, nonmaskable interrupts will definitely interrupt the processor.

All of the above apply to an earlier version of the CGRS 6502 CPU. Recent correspondence with Mr. Goble indicates that the CPU board has been redesigned and *now* generates SINP, SOUT and PSYNC. And NMI is jumper selectable. Based upon this data, "redefinition" as to S-100 pins for the new CGRS 6502 CPU is not appropriate.

It should be noted that prior to approving the 'proofs' in February 1978, I made additional inquiries to the manufacturers for updated information and a complete bus pin usage, not just undefined pin usage as in the first request. I received no additional response from Mr. Swope for the CGRS 6502.

Mr. Goble's *Interface Age* article was referenced as a source of information on the S-100 bus, and for a discussion of memory mapped I/O versus port select I/O.

Bill Fuller
Grand Prairie TX

Corrections to Table 1 of "Compatibility and the Altair Bus."

			SEALS *BBUC*	MINITERM MERLIN/*ROM/RAM*	CROMEMCO Z-2 SYSTEM	BISI CCD MEMORY
15	*−12 VDC*	BATTERY BACKUP	●			
65	$\overline{\text{WRITE}}$	WRITE ENABLE				●
67	$\overline{\text{PHANTOM}}$	PHANTOM DISABLE		○	○	
	$\overline{\text{NMI}}$	NONMASKABLE INTERRUPT				
	$\overline{\text{RFSHDSBL}}$	REFRESH DISABLE		●	○	
	$\overline{\text{MDSBL}}$	MEMORY DISABLE			●	

Dots represent additions to Table 1 and circles represent deletions. Italics indicate changes to copy.

Give It a 10

I have had 10 years of electrical engineering education and have worked in the industry for 14 years; however, I have not yet learned everything there is to know about electronics, and I am not likely to even reach a satisfactory compromise before I die. Unlike those engineers who have acquired all knowledge, stored it, and are able to produce undistorted truisms upon demand, I occasionally require an explanation at elementary levels.

I have been studying microprocessors and related devices since Intel introduced the 8008; however, I had never seen a comprehensible article, chapter or paragraph describing memory expansion beyond 1K until George Young's "Kilobaud Klassroom No. 10" in your May 1978 issue.

I disagree with Mr. Young and microprocessor manufacturers concerning their memory addressing capabilities, however. At this time, the 16 address lines of modern microprocessor chips *do not* provide the capability of selecting 65,535 discrete memory locations. Rather, the 16 address lines plus a hell of a lot of hardware does.

I thoroughly enjoyed Mr. Young's article and consider it to be the finest presentation on microprocessors and related devices ever put into print.

Robert C. Arp, Jr.
Minden NV

Responses Flow on Brooks Article

I just received July ('78) *Kilobaud* and enjoyed it very much because of the heavy coverage for the SWTP system.

I especially enjoyed Emerson Brooks' "Taming the I/O Selectric." In this article I was reminded of a trick with SWTP 8K BASIC that I have used for some time now to limit the RAM taken by the interpreter. I am enclosing this and hope that it might be of some use to others. I hope that by sharing such things we all may gain.

Thank you very much for a fine magazine each month. Please don't stop!

Dexter S. French, Jr.
Longwood FL

Limiting the buffer size of SWTP's BASIC.

When initiated, SWTP's BASIC writes 55s into memory to determine the actual size of the available RAM. To fool the interpreter into taking a smaller block, simply change the contents of $0C41 to one more than the highest address that you wish 8K BASIC to reserve for its buffer. Thus:

12K— $3000
16K— $4000
20K— $5000
•
•
32K— $8000 : the present contents of $0C41
Now you can reserve some RAM for yourself.

Fig. 1.

I got my first issue of *Kilobaud* the other day and was interested to see the article on interfacing a typewriter as a printer ("Taming the I/O Selectric" by Emerson Brooks, June, July 1978), since I have been working on a similar idea.

The software written by Mr. Brooks uses a technique he calls "software switching," better known as "self-modifying code." Experienced programmers know, from education or experience, that this technique should be strictly avoided, and beginning programmers should not get into the habit of using it, for these reasons:

1. The most oft-quoted argument is to warn that if there is a

reset in the middle of the run, the instructions would be left in a garbaged state. Running it again under these conditions could cause a "crash."

2. Suppose someone else (or the programmer two months later) wants to improve on the program. Since he is not (or is no longer) familiar with the program, he consults the flowcharts and tries to analyze the flow, comparing the flowcharts against the source code. Since flowcharts cannot illustrate the technique, and source code is inherently confusing, it can be very difficult to understand the algorithms used (this argument applies to "hidden RTS" also).

3. We have all had "experiences" trying to debug complex programs. Now consider trying to debug a program that is continually changing itself!

Enough horror stories; and is there an alternative? Yes. One or two bytes of memory can be set aside as flags. Each byte can hold eight "software switches." In the program, decisions are based on a BIT test, with a conditional branch after it.

Self-modifying code can always be avoided, and always should be.

Nathan Myers
Hilo HI

Re-iteration

The discussion between Dr. Hoffman and Mel Baker in the Letters column of your August issue concerning the use of radians or degrees in the iterative solution of equations containing trigonometric functions is of special interest to programmers. However, I am puzzled by Mel Baker's explanation that the use of "units degrees squared" is not permissible, but that "units radians squared" is permissible.

This is a point that ought to be cleared up for those programmers who may be called upon to solve such problems. I am sure Mel Baker can clear this up. But degrees and radians are both dimensionless and can be used as arguments for trig functions as well as for exponents. I don't think that dimensional analysis is the answer here. Rather, I think the answer lies in the area of circular functions (that is, we do not think of the functions relating to the sides of a triangle). Instead we think of the "wrapping function" where the real line is related to the points on a unit circle. This provides the relationship between function and argument for proper iteration.

Thanks to Dr. Hoffman for bringing up the question. It is one that other programmers may be stumbling over also. But it is customary to use the radian as the unit angle. When degrees are used, it is usually denoted by the usual symbol, such as 23°. If these standards are used, we will have less confusion and better communication.

Charles E. Lowe
Round Rock TX

Pro FORTRAN

With reference to the letter by Ronald Dove (issue No. 19, p. 18)—I too read with interest the benchmark comparisons of the various BASIC interpreters ("BASIC Timing Comparisons," June 1977, p. 66), but my pulse was quickened by the letter from Mr. Dove and his benchmark routines for FORTRAN. About time it was realized that many of us need more performance than the available BASIC interpreters can provide!

Using the program submitted by Mr. Dove, I pulled four FORTRAN compilers off the shelf and proceeded to run the test. Included were Microsoft Ver. 3.0, Scientific Controls Ver. 3.2, TDL (Small Systems Services) Ver. 2.1 and Cromemco FORTRAN. The Cromemco was clearly Microsoft Ver. 2.7, and was not included in the comparisons, since it was identical to their Ver. 3.0 in times. Also, Mr. Dove's execution times agreed with mine, since we are using similar machines (Z-80, 4 MHz and one wait state), but I am showing my timings for comparison with the others (see Fig. 1). Average execution times listed are in seconds.

I hope this may be of interest to readers who are by now beginning to "pick up" on the FORTRANs that are currently available. Thank you for your outstanding magazine, and I hope you will continue to provide these interesting benchmarks adapted to the languages that are now appearing.

Roger L. Modeen
Seattle WA

Benchmark#	Microsoft 3.0	TDL 2.1	Sci. Cont. 3.2
1	0.0225	0.16	0.022
2	1.40	1.36	2.55
3	5.00	9.11	28.0
4	5.05	9.12	28.1
5	5.06	9.20	28.1
6	5.57	10.6	28.3
7	6.09	11.6	30.9

Fig. 1.

RPG ASAP SVP

I have been reading your magazine for about a year now. You have interesting articles and programming tips for the computer hobbyist and small businessman. But—can you tell me why you haven't ever mentioned RPG1 or RPG2 (it stands for Report Program Generator)?

RPG is used on small machines (System 3 models 10, 12, 15 and Systems 32s and other miscellaneous machines). It's an easy, fast language, very versatile in file structure and business-type processing.

I work with RPG every day. It's the only language that I care to work with for business and games. RPG is easier to read than FORTRAN or COBOL, more flexible than BASIC, and in general takes fewer lines of coding.

I do hope to hear from you.

Debra Mydland
Bakersfield CA

As we have stated before, we don't write the articles—our readers do. If RPG becomes a more popular microcomputer language, we'll probably start to receive RPG articles.—Editors.

Northern Notes

A few notes from a satisfied Canadian reader:

1. Items move faster through our mail system if you include the Postal Code. This is that funny series of letters and numbers that appear after the province. My postal code is V6S 1B2. Note that the format is letter, number, letter, *space*, number, letter, number. Although this may not be quite as simple as your ZIP code, it does mean that a letter addressed: Andrew Bates, Canada V6S 1B2, will be delivered to me. The postal code pinpoints the side of the street in a residential block or even the floor of a building in a business district. How's that for precise! (Software writers take note: We Canadians need at least 6 characters for the postal code and 4 characters for the province (state). If you are going to check the ZIP for all numbers, please put the check in a subroutine so we can replace it with a suitable check for our postal code.)

2. WATS lines do not cross international borders (at least that is what the telephone operator told me). This means that we people in Canada can't phone you for free as everyone else can. How about letting your people accept collect phone calls from Canada only so we can use A. G. Bell's famous invention, instead of having to spend hours slugging away at the old typewriter and then waiting for an erratic mail service on both sides of the border.

3. Another small request for software writers who are mailing things to Canada: If your package costs $75 and is distributed on North Star diskette, for instance, please mark the customs declaration as:

DISKETTE $6
PRINTED MATTER $69

If you mark the price as $75 we end up paying duty on the *diskette* as though it costs $75. Printed matter comes across the border duty-free, and there is no duty on an item of less than $10 value.

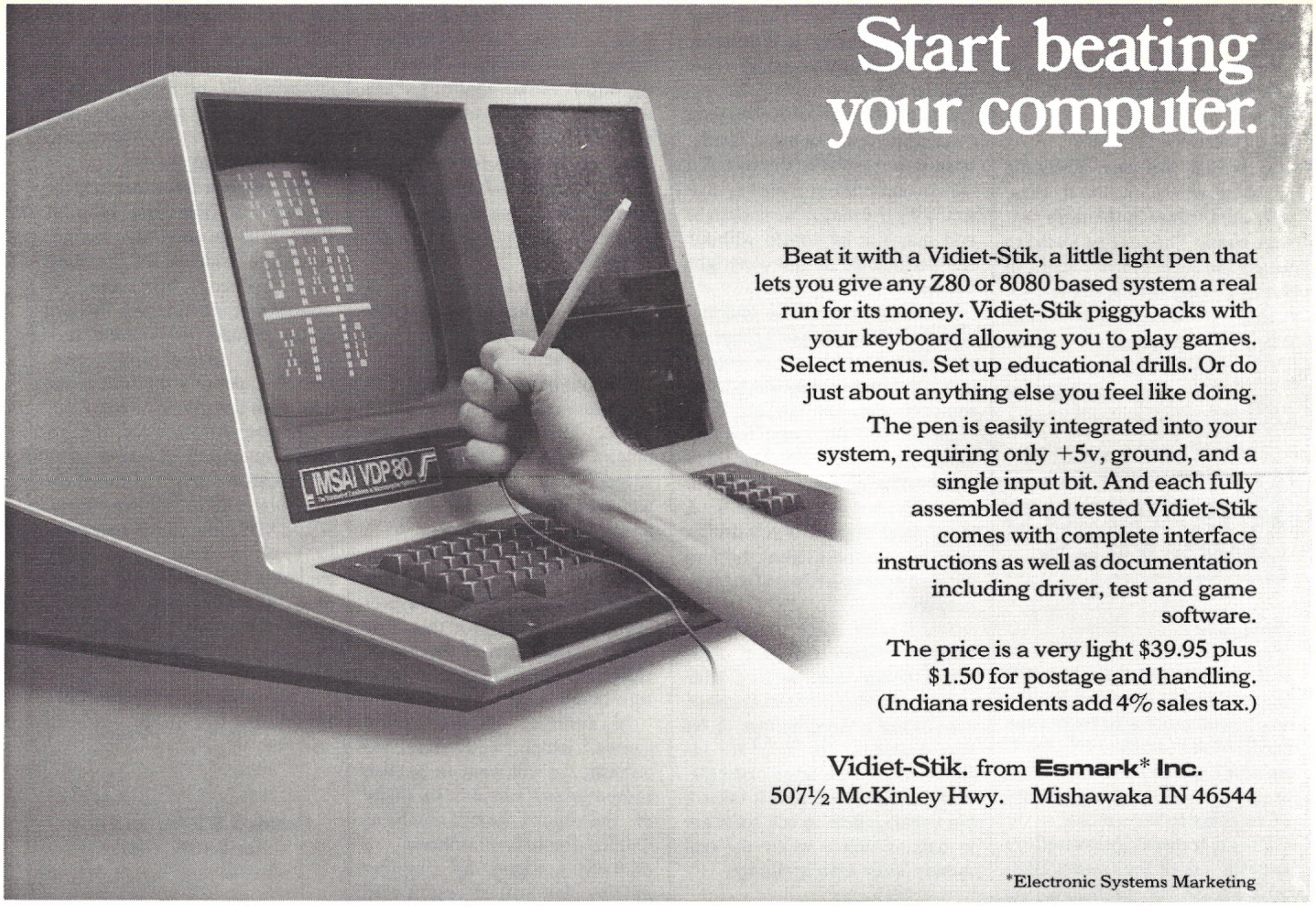
Thanks for listening.

Andrew Bates
Vancouver BC

4220's OK, but . . .

A while ago we received a call from someone saying that line 4220 in Program E of "5 Minutes or 5 Hours?" by Tom Doyle (May 1978, p. 102) reads: GOSUB 9210. The caller pointed out that there is no line 9210 and wondered if this is an error. Tom Doyle's response follows.—Editors.

This is not an error. My article indicates that one should remove lines 9220-9340 from the original Do-All program and replace them with my lines 9220-9340. When this is done, line 9210 remains from the original Do-All



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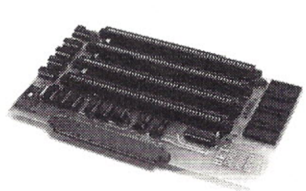

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* PET is a Commodore product

program—it is a remark statement.

One correction I did find was in line 160 of Program D. It should be:

```
160 IF D(I)<=D(L) THEN 210
```

The = was left out. The only problem would occur if there were data values in the table that were equal. The routine I used to set up the table did not result in duplicate data values, so the error in line 160 was not noticed. I hope this cleans things up.

Thomas E. Doyle
Madison WI

PUBLISHER'S REMARKS

(from page 7)

as it ever was, yet the sale of CB rigs has all but disappeared. We don't need more articles like the one in *Money* on the PET; but if we don't get some darned good programs out there quickly, we're going to have more.

Programmers interested in knowing about the Instant Software system for publishing and marketing software should drop an SASE to get our "Dear Programmer" letter. Programmers who are trying to market their own programs should at least look into the possibilities of Instant Software's marketing their programs. I have a sheet, "Selling Your Software the Easy Way," for small software marketers. SASE please.

Software Publication

Since several readers have asked recently about the possibility of selling software that has been published in *Kilobaud*, there is obviously a need for some clarification.

The publication of software in a magazine does not put that software into the public domain. To the contrary, the software is protected by the magazine copyright and may not be copied without the permission of the copyright holder.

In practice there is no problem with a reader typing in a program and using it for his own entertainment, but once a copy is made for someone else, the law has been violated. It's the same for any hardware articles. You can build a piece of equipment described in an article, but you are open for a lot of legal troubles if you decide to go into business selling the item without getting a release from the magazine.

So, if you want to get into business selling software, then you'd better start writing your own programs. Your chances of convincing a programmer to let you distribute his software instead of having a large organization do it are minimal. It takes a big organization to sell software in bulk, which is where the real money is for a programmer.

Casino Game Programs

The games of craps, roulette, blackjack, etc., are fun to play against the computer . . . at least for a while. While there is no doubt that any well-rounded library of computer programs should include the popular casino games, I think this should be carried a step further.

I would like to see a craps game program that will allow me to play craps with other people or just against the computer. I would further like to be able to use this game to sharpen my own skills at craps. This would mean being able to call up a display of the odds I am up against for any throw for all of the normal casino bets and side bets. There are a couple of systems for taking the best advantage of the odds in craps, and I would expect the game to tutor me in these systems.

The same deal would go for blackjack. The most popular system for winning at blackjack calls for keeping track of the cards that have been played with the house using a double deck of cards. This system could be taught via a program. I would suspect that such a program would be a lot more popular than a plain blackjack program.

Few people understand the odds involved in many of the possible roulette bets, so a program could help with this. The games should permit the use of either the single-zero or double-zero board.

In addition to the casino games, which we'll want to publish, we will want to publish computerized versions of many of the board games such as Cubic, Pegitty, Parcheesi . . . and why not have the computer able to play against you in card games . . . there are hundreds. I know I would enjoy a good fight in Russian Bank, cribbage, casino, crazy eights, double solitaire, various rummy games, and even bridge.

Would it be possible to put together a list of words so a computer could play a game of Boggle against you? It might be possible if you limited it to just three- and four-letter words. I enjoy Boggle and would like to see a computerized game that uses the same letter possibilities as the Parker Brothers game. Sherry and I usually carry Boggle, a cribbage board and an anagram game with us on trips to make those hours on a plane go by relatively painlessly.

There are many board and card games that can be computerized—what are you waiting for?

Reader Responsibility

One of your responsibilities, as a reader of *Kilobaud*, is to aid and abet the increasing of circulation and advertising, both of which will bring you the same benefit: a larger and even better magazine. You can help by encouraging your friends to subscribe to *Kilobaud*. Remember that subscriptions are guaranteed—money back if not delighted, so no one can lose. You can also help by tearing out one of the cards just inside the back cover and circling the replies you'd like to see: catalogs, spec sheets, etc. Advertisers put a lot of trust in these reader requests for information. To make it even more worth your while to send in the card, a drawing will be held each month and the winner will get a lifetime subscription to *Kilobaud*!

The winner of a lifetime subscription to *Kilobaud* is Charles H. Beineman of Englewood OH.

NEW PRODUCTS

(from page 17)

The SMART cassette operating system handles all essential functions, such as motor control, file formatting, labeling, searching and generation of inter-record gaps. It eliminates the need for control program bootstrapping. To perform a cassette search, load or dump, the user simply "calls" the desired on-board operating routine.

The cassette interface may be operated at tape data rates of 1200, 2400 or 4800 bits/second. A reliable modified KC Standard (dual frequency FSK) modulation scheme is employed. Integral motor control drivers are provided. A special input preamplifier permits the unit to be used with any "hi-fi" recorder.

For user convenience, the on-board operating programs may be relocated to any position of the computer's addressable memory. A SMART text editor operating system is also optionally available. The MS-CIO is supplied fully assembled and tested, complete with the SMART cassette/tape operating system for $205.

Xecon Micro, PO Box 267, Hawthorne CA 90250.

Coding/CRT Layout Forms for BASIC Users

A new coding form designed especially for people who program in BASIC or other line-number-oriented languages is now available from Stirling/Bekdorf. With grid lines lithographed in soft blue on a brilliant white sheet, Form 78C1 combines coding and interactive CRT layout functions into one unit and gives 14 percent more coding lines as an additional bonus, yet the form retains the roomy 6mm × 3mm grid you need for comfortable writing (¼-inch H × 1/8-inch W nom.). Both 16 × 64 and 24 × 80 standard CRT formats are indicated on the form, so it's easy to see where display characters will fall, no matter what type CRT your computer uses.

Developed primarily for mini- and microcomputer programming. Form 78C1's paper stock is a husky 22# opaque sheet with surface engineered to take plastic-tip marker without spreading and accept soft pencil equally well.

It's actually pure enough for magnetic-ink character-recognition-scanning equipment. It's available in either 3-hole punched looseleaf style or in 3-hole punched 50-sheet pads with chipboard backing.

Stirling/Bekdorf, 4407 Parkwood, San Antonio TX 78218.

Jim Trageser
5648 Brookbank Dr.
Kettering OH 45440

Budget System with KIM

A lot of us got started with a KIM-1. This article shows you how to expand your basic KIM economically.

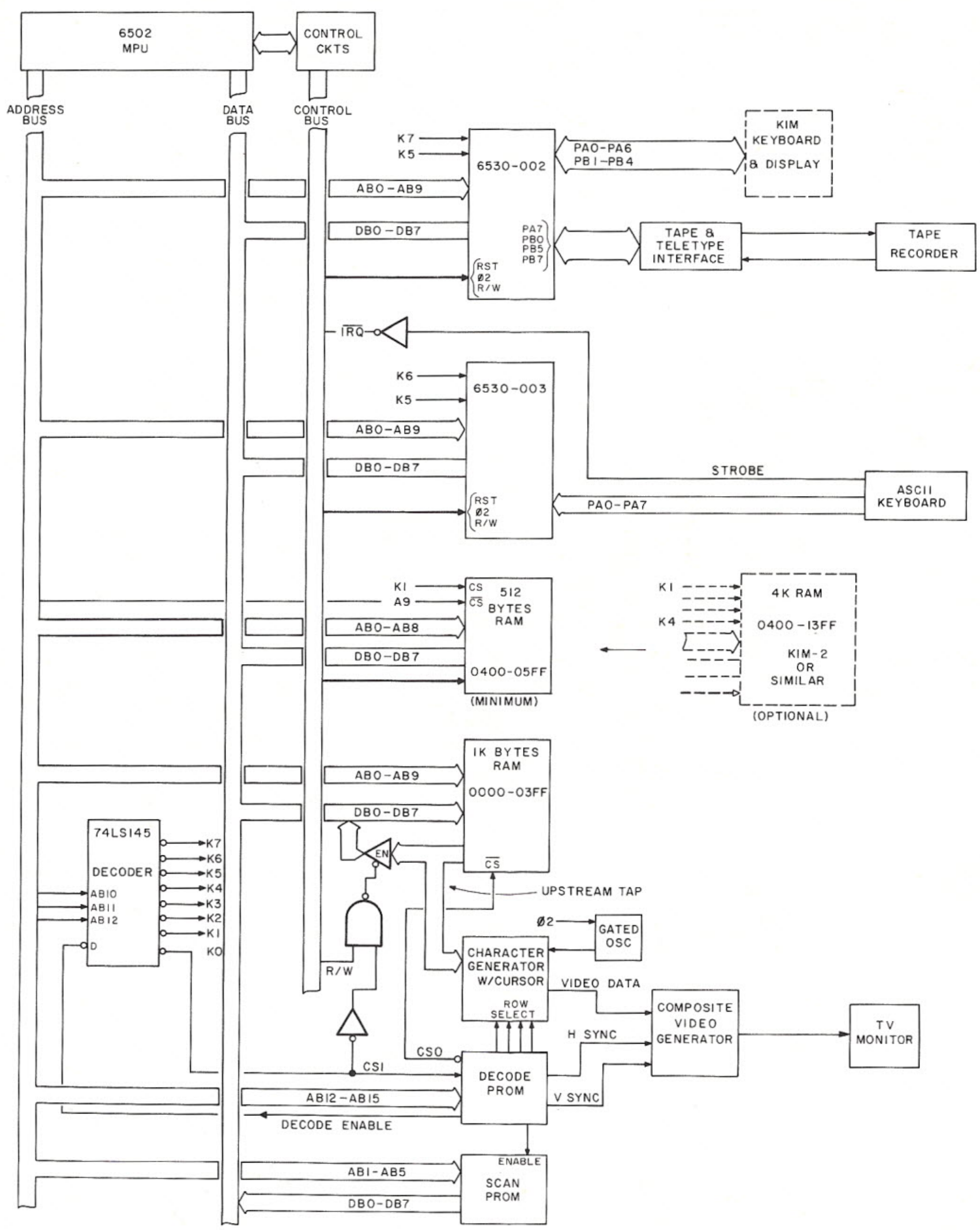


Fig. 1. AKIM block diagram.

This article shows you how to advance beyond the hex keyboard and display without spending more than double your initial investment in KIM. Don Lancaster's article, "A TVT for your KIM," in the June 1977 *Kilobaud* describes an excellent low-cost way to add a quality CRT display to your microcomputer. To obtain full terminal capability, you need only add a low-cost ASCII keyboard to Don's TVT-6L. New ASCII keyboard kits or surplus-assembled keyboards can be purchased for less than $49. Total TVT and keyboard cost can be less than $100.

This article shows how to add the keyboard and use it instead of the hex keyboard on your KIM or home-brew 6502 system. Software AKIM (ASCII keyboard input monitor) will allow you to perform KIM monitor functions using the TVT and ASCII keyboard. If you have been reluctant to add Don's TVT-6L setup because of its use of memory locations 2000 to EFFF, *apparently* excluding them from other use, I will show a simple technique to switch between TVT and full memory usage under software control.

Background

MOS Technology was the first to make it possible for many microcomputer enthusiasts to get hands-on experience without investing a lot of time and money in designing a personal computer or having a high degree of technical expertise.

I started my 6502-based system as a home-brew computer because I was determined to get some hands-on experience with microprocessors (this was before the KIM-1 had been introduced). It was the only way to go at the time.

After five months of designing and building, I was just starting to write some simple

AKIM. Home-brew KIM-1 after TVT-6L and ASCII keyboard are added. Microcomputer, power supplies and keyboard are mounted in surplus KSR 35 enclosure.

software and proudly watched my microcomputer single-step through the instructions. *Then* the KIM-1 was introduced. As a pre-KIM 6502 owner, I was able to purchase the 6530-002 and 6530-003 memory-I/O timer arrays with KIM software in ROM. Although my microcomputer may not look outwardly like a KIM-1, functionally it is identical, including the cassette interface.

Once thoroughly comfortable with my minimum computer system and having developed some expertise in programming skills, I wanted to add a terminal: either a Teletype or CRT with keyboard. Planning this next step, I also wanted to add assembler and BASIC language capability. All this requires another 4K to 8K of memory.

For over six months I seriously searched for the lowest-cost method of getting to the next step short of devoting a lot of time to designing and building my own. Even with the significant reductions in the costs of memory and keyboards during the past year, the cost of adding a terminal and 4K to 8K of RAM was still three to four times the original cost of KIM-1.

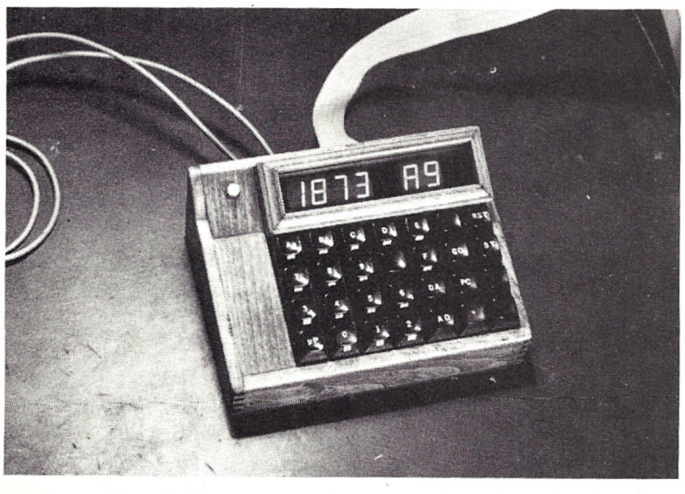
Assuming a potential user has a fixed educational or hobby budget, his goal is to obtain the most capability within the budget. Mine started out as a continuing education budget, but I've had so much fun learning that it has become difficult to differentiate between the educational and the hobby aspects.

I was trying to find a way to reduce the cost of the terminal so I could allocate more of my budget to memory expansion. The TVT-6L was just what I was looking for. The material costs were low, and the simplicity of the hardware required minimum construction time. Furthermore, I could get back to what I really wanted to do—play with the software.

Systems Configuration

AKIM requires a minimum of 512 bytes of RAM added to the BASIC KIM-1 system. This allows you to use the TVT-6L in the 16 line x 32 character-per-line format with AKIM and Don's scrolling cursor program. For 13 x 64 or 25 x 64 screen formats, you need the equivalent of KIMs 1 and 2. I had an extra 512 bytes of memory left over from my original home-brew (pre-KIM) system.

In the KIM-1-configuration conversion, I added a full 1K of RAM, using Fairchild 2102L1s to keep the power-supply requirements low, and located the entire 512 bytes at address locations 0400 to 05FF. A block diagram of the system with TVT-6L, ASCII keyboard and



Home-brew KIM-1 remote keyboard and display. Display drivers, TTY interface and audio cassette interface electronics are located in keyboard enclosure.

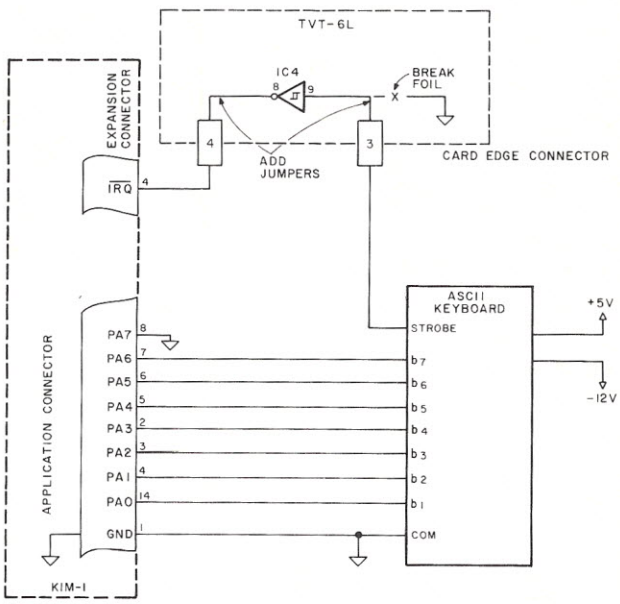
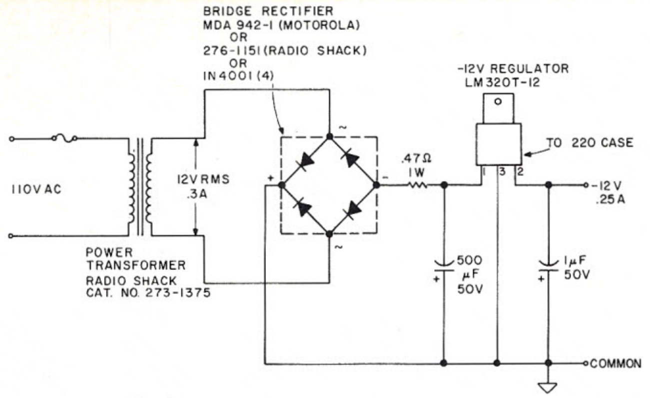


Fig. 2. ASCII keyboard interface wiring.



Notes. For +5 V supply.

- Substitute LM340T-5 for LM320T-12 regulator.
- Reverse connections (+/−) to bridge rectifier and filter capacitors.
- *Separate transformers must be used* for positive and negative supplies.
- To increase output current to 1 A maximum, change transformer to 12.6 V @ 1.2 A rating (Radio Shack catalog no. 273-1505). Add heat sink to voltage regulator, change 500 uF capacitor to 2000 uF.

Fig. 3. Schematic diagram. −12 V power supply for ASCII keyboard.

PA7	PA6	PA5	PA4	PA3	PA2	PA1	PA0
0	b7	b6	b5	b4	b3	b2	b1

MOST SIGNIFICANT DIGIT									
HEX		0	1	2	3	4	5	6	7
	BINARY b4 b3 b2 b1 (b7 b6 b5 →)	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
0	0 0 0 0	NUL	DLE	SPACE	0	@	P	\`	p
1	0 0 0 1	SOH	DC1	!	1	A	Q	a	q
2	0 0 1 0	STX	DC2	"	2	B	R	b	r
3	0 0 1 1	ETX	DC3	#	3	C	S	c	s
4	0 1 0 0	EOT	DC4	$	4	D	T	d	t
5	0 1 0 1	ENQ	NAK	%	5	E	U	e	u
6	0 1 1 0	ACK	SYN	&	6	F	V	f	v
7	0 1 1 1	BEL	ETB	'	7	G	W	g	w
8	1 0 0 0	BS	CAN	(	8	H	X	h	x
9	1 0 0 1	HT	EM	)	9	I	Y	i	y
A	1 0 1 0	LF	SUB	*	:	J	Z	j	z
B	1 0 1 1	VT	ESC	+	;	K	[	k	{
C	1 1 0 0	FF	FS	,	<	L	\	l	¦
D	1 1 0 1	CR	GS	−	=	M	]	m	}
E	1 1 1 0	SO	RS	.	>	N	^	n	~
F	1 1 1 1	SI	US	/	?	O	_	o	DEL

Table 1. ASCII character set.

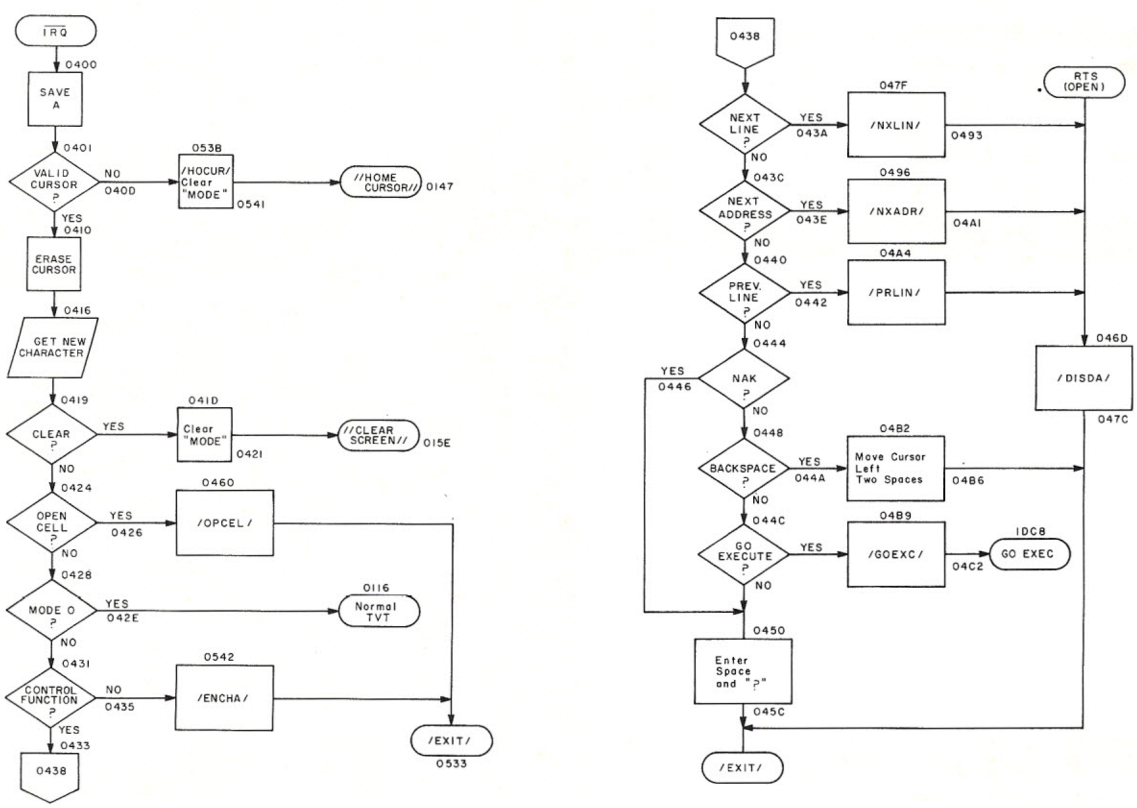
added RAM is shown in Fig. 1.

Note that the KIM-1 decoder IC (U4) is shown as 74LS145. This may not be necessary at this time in your system, but with the added loading of the TVT-6L DECODE PROM on AB12, I recommend changing the existing 74145 with 74LS145 to reduce the address-bus loading. This allows other decoders to be added to the high-address lines for memory expansion without resorting to bus drivers in these lines.

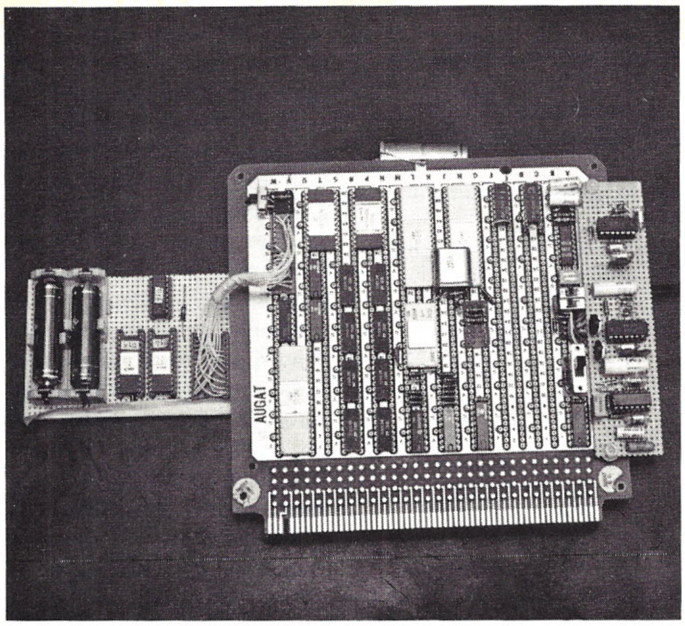
Adding the ASCII Keyboard

AKIM is based on connecting a seven-bit parallel ASCII-coded output keyboard to port A of U3 on KIM-1. This connection is made via PA0-PA6 at the application connector. PA7 must be tied low; otherwise, it may be read and displayed as a cursor bit. The keyboard should have a positive logic output. Some available keyboards use a negative logic (true = 0) output. These keyboards require inverters between the keyboard output and the port A input to work with the AKIM and scrolling cursor software as written.

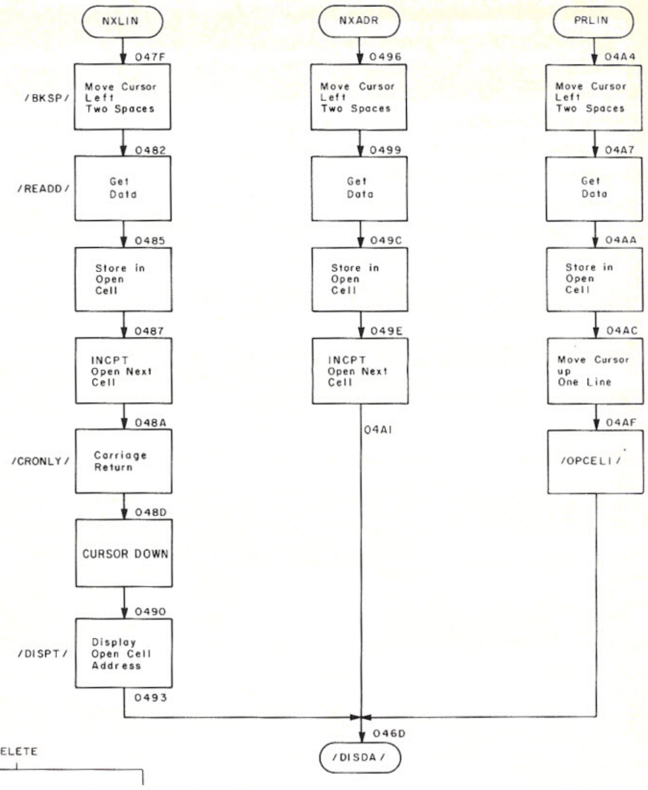
Other than the required power connection to the keyboard, only one more connection is required: the *strobe*. The keyboard strobe output must be connected to the KIM-1 $\overline{\text{IRQ}}$ line available at the *expansion* connector. The strobe output



AKIM flowchart. Main routine.



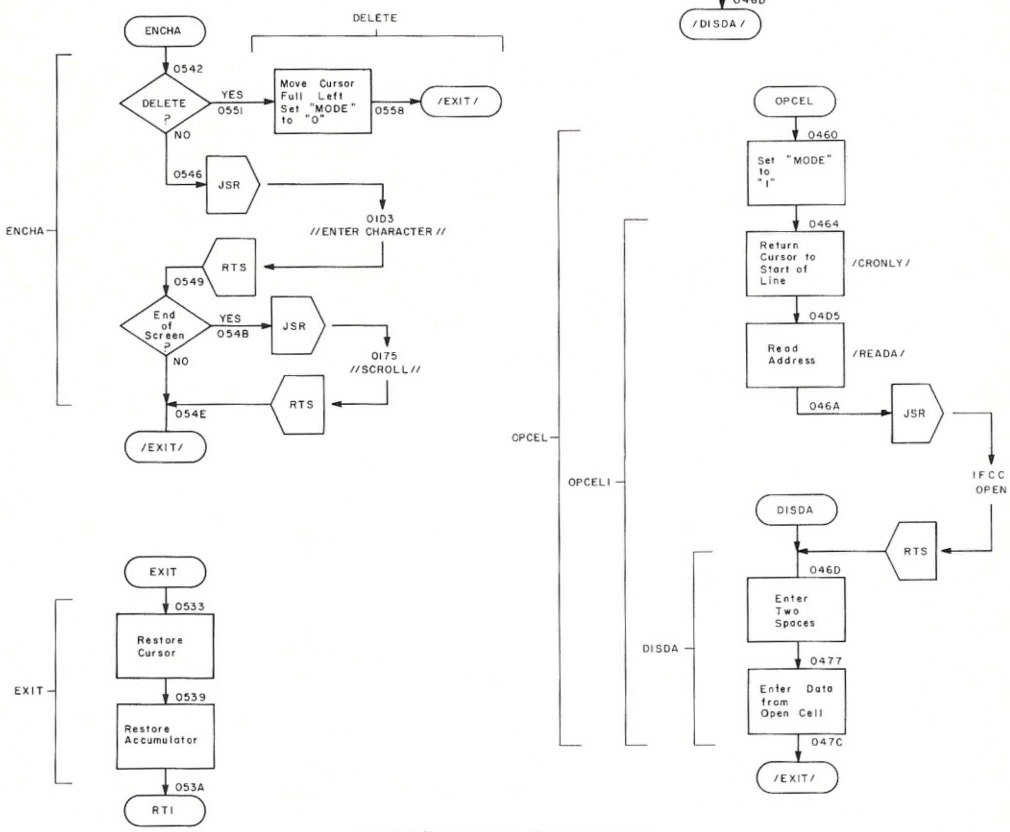
Home-brew KIM board with TVT-6L circuits added on right. CMOS RAM with batteries is on left.



from the keyboard must be normally high and pulse low when active to work with the $\overline{IRQ}$ input. If your keyboard is like mine, the strobe and data outputs are all positive logic, which requires the strobe signal to be inverted prior to connection to the $\overline{IRQ}$ input. If you don't want to add an extra IC, there is an unused section (pins 8 and 9) of IC4 on the TVT-6L for this purpose.

If the TVT-6L is on a printed circuit board, you must first cut the trace connecting pin 9 of IC 4 to ground. Then solder jumper wires from pins 8 and 9 to two unused pins (3 and 4) on the TVT-6L connector (see Fig. 2). Some keyboards may also have a *parity* bit output that is not necessary in many applications and is not used in AKIM.

The power requirements for my keyboard were +5 volts at 350 mA and −12 volts at negligible current. If your keyboard is similar and you are using the power supply recommended for the KIM-1, the addition of the TVT-6L and ASCII keyboard will cause the +5 V power requirements to exceed power-supply capacity. The −12 V requirements are attained by using a circuit similar to that shown for the +12 V supply in the KIM-1 user's manual. Fig. 3 shows a variation of the power-supply



AKIM flowchart. Subroutines.

Introduction to AKIM Program

AKIM is a program that allows owners and users of KIM-1/6502 systems with a TVT-6L TV interface and an ASCII keyboard to use the TV terminal in a monitor mode in lieu of the normal KIM-1 keyboard. Functions provided include:

1. Calling any memory location and displaying the contents stored (open cell).
2. Stepping to next address, displaying the address and contents on the next line by pressing LF.
3. Stepping to the next address without displaying address but displaying contents of address two spaces to the right of the previous address data by pressing TAB.
4. Changing contents of open cell by pressing back space and typing in new data prior to execution of LF or TAB.

5. LF and TAB functions automatically load data displayed to left of cursor into open cell and increment address to open next cell.
6. Vertical tab, VT, function moves cursor to start of previous line and reopens cell displayed there.
7. Exit of the monitor routine is accomplished by either the DEL, CAN or GS keys.
8. Execution of the DEL function returns the cursor to the start of the present line and returns the program to the TVT mode for free-form use.
9. Execution of the CAN function clears the screen, returns the cursor to home and returns the program to the free-form TVT mode.
10. Execution of the GS function causes the system to exit the monitor program and execute the program starting at the address displayed at the beginning of the line displaying the cursor.

Monitor routine for KIM-1/6502 systems with TVT-6L interface and ASCII keyboard input.

Hardware Required

(1) KIMs 1 and 2 or KIM-1 with add-on memory of 512 bytes.
(2) TVT-6L TV interface described by Don Lancaster in June 1977 *Kilobaud*.
(3) ASCII keyboard interfaced to Port A application input.

Associated Software

(1) KIM subroutines—INCPT (1F63)
PACK (1FAC)
OPEN (1FCC)
(2) TVT-6L RASTER SCAN program (June 1977 *Kilobaud* p. 58).
(3) Scrolling Cursor program (June 1977 *Kilobaud* pp. 60, 61 and 62) with following correction and change:
—Location 011D listed in error. Change "30" to "40" at this location.
—Replace ///RESTORE CURSOR/// subroutine starting at 014A with the following:

```
014A JMP  4C   (2C)  (05)   Check "MODE" & finish.
014D NOP  EA
014E NOP  EA
014F NOP  EA
0150 NOP  EA
0151 BRK  00                Trap
```

Key Function List

CLEAR — CAN (18),	Clear screen & reset MODE to 0. //TVT ONLY//.
OPEN CELL — SI (0F),	Place in monitor mode (MODE 1) and open cell specified at start of line. Display current data in cell.
BACK SPACE BS (08),	Move cursor two spaces to left. Used as a convenience for altering cell data and writing new programs.
TAB — HT (09),	Enter data displayed left of cursor in open cell. Open next cell, tab two spaces to right and display current data of new open cell.
LINE FEED — LF (0A),	Enter data to left of cursor in open cell. Open next cell, command CR & LF, display address of open cell at start of next line, enter two spaces and display current data of open cell.
DELETE — DEL (7F),	Exit monitor mode, (clear "MODE" to 0), return cursor to start (left side) of current line.
PREVIOUS LINE — VT (0B),	Move cursor to start of line above current line. Open cell and display current data in open cell.
GO EXECUTE — GS (1D),	Exit monitor program and execute program starting at location displayed at start of line.

Attempts to execute any other control functions while in monitor mode will cause ? to be displayed on screen.

Program Space: 0400—055C

Start: IRQ
End: RTI

Tape Ident: 1D

Start-up: (1) Set IRQ, 17FE = 00
17FF = 04
(2) Initialize 00F1 — 00
(3) After all 3 Programs loaded go to 17A6 & press GO
(4) The first keyboard function initiated should be CLEAR SCREEN (CAN).

circuit shown in the manual.

This should take care of the requirements for most ASCII keyboards. However, you may want to consider adding a power supply at this time to take care of future memory expansion. Power-supply kits and surplus power supplies are available at reasonable prices. Scan the ads in *Kilobaud*.

When you have the keyboard connected, check for proper code inputs from the keyboard before trying the keyboard software. Call up address 1700 on your KIM keyboard. Since the Reset function or initialization of KIM sets all data-direction registers as inputs, PA0 through PA7 at the *application* connector will be set up as inputs. It is not necessary to reinitialize the data-direction registers as inputs. Press any character key on the ASCII keyboard. The data displayed on your KIM display should be the two-digit hex equivalent of the binary ASCII code. See Table 1 for ASCII-to-hex code conversions.

After you have verified that the keyboard is correctly entering data, you are ready to run the cursor or AKIM software. Prior to jumping to the SCAN routine, set location 00F1 to 00 to insure that the IRQ mask is disabled. Load hex 0400 in the IRQ vector (17FE and 17FF) if you are running AKIM.

Before we go on to the AKIM software, a comment regarding the interface to a TV monitor is in order. If you are using a portable TV other than the Panasonic T-126A mentioned in Don's article, some adjustment of the dc offset voltage at the TV output jack (J1) may be necessary. I used a 9-inch RCA model AJ-005B b & w set. The dc bias of the TVT-6L was too high, as evidenced by a white screen and no sync. The dc level can be reduced in .5 V increments by shunting one or more of the series diodes D5-D8 between J1 and J2.

AKIM Software

With the keyboard interface functioning, I loaded in Don's Scan and Scrolling Cursor programs. The TVT came to life.

After minor sync adjustments, I checked out the keyboard functions. Every function operated as expected, except for the Clear function. The problem was traced to a typo in the Scrolling Cursor program listing. The branch instruction at location 011D should be 40 instead of 30. After this correction was made everything operated correctly.

At this point, I turned it over to the kids while I planned the next step. They had a great time drawing pictures with ASCII characters and playing word games and Ticktacktoe.

AKIM was developed to allow the TVT and ASCII keyboard to be used instead of the KIM keyboard and hex display for the basic monitor function using minimum additional program space. Don's original Scrolling Cursor program was retained to allow the keyboard to operate in either the AKIM monitor

Program listing.

	Address		Op code		Symbol	Mnemonic		Comments
	0400	48				PHA		Save A
	0401	A0	00			LDY	#$00	Reset Y index
	0403	A5	EE			LDA	CURSH	Get cursor and test
	0405	C9	04			CMP	#$04	Below max.?
	0407	B0	04			BCS	home	No! Home cursor
	0409	C9	02			CMP	#$02	Above min.?
	040B	B0	03			BCS	ecur	Yes! Get cursor
	040D	4C	3B	05	home	JMP	HOCUR	No! Jump to HOME CURSOR
	0410	B1	ED		ecur	LDA	(ED),Y	Get cursor character
	0412	29	7F			AND	#$7F	Erase cursor
	0414	91	ED			STA	(ED),Y	Replace character
	0416	AD	00	17		LDA	(A par. input)	Get new character
	0419	C9	18			CMP	#$18	Clear Screen?
	041B	D0	07			BNE	CONT1	No! Go to CONT1
	041D	A2	00			LDX	#$00	Yes! Clear MODE
	041F	86	FF			STX	MODE	
	0421	4C	5E	01		JMP	015E	Go clear screen
	0424	C9	0F		CONT1	CMP	#$0F	Open cell?
0460	0426	F0	38			BEQ	OPCEL	Yes!
	0428	A6	FF			LDX	(MODE)	Check mode
	042A	E0	00			CPX	#$00	
	042C	D0	03			BNE	MODE1	Mode 1
	042E	4C	16	01		JMP	0116	Mode 0
	0431	C9	20		MODE1	CMP	#$20	Character to enter?
	0433	90	03			BCC	GETCON	No! Which control?
	0435	4C	42	05		JMP	ENCHA	Enter Character
	0438	C9	0A		GETCON	CMP	LF	Start new line?
047F	043A	F0	43			BEQ	NXLIN	Yes!
	043C	C9	09			CMP	HT	Open next cell?
0496	043E	F0	56			BEQ	NXADR	Yes!
	0440	C9	0B			CMP	VT	Previous Line?
04A4	0442	F0	60			BEQ	PRLIN	Yes!
	0444	C9	15			CMP	NAK	(Future mode)
	0446	F0	08			BEQ	LEAVE	Invalid control
	0448	C9	08			CMP	BS	Back space?
04B2	044A	F0	66			BEQ	BCKSPA	Yes!
	044C	C9	1D			CMP	GS	Go Execute?
04B9	044E	F0	69			BEQ	GOEXC	Exit to called program
	0450	A9	20		LEAVE	LDA	#$20	Print "space"
	0452	91	ED			STA	(ED),Y	cont.
	0454	E6	ED			INC	ED	Increment cursor
	0456	A9	3F			LDA	#$3F	Print "?"
	0458	91	ED			STA	(ED),Y	cont.
	045A	E6	ED			INC	ED	Increment cursor
	045C	4C	33	05		JMP	EXIT	Restore cursor and return to scan
	045F	EA				NOP		
					; Subroutines			
					;			
					;			
					;			
					; Open New Cell			
	0460	A9	01		OPCEL	LDA	#$01	Set "MODE"
	0462	85	FF			STA	MODE	to "1"
	0464	20	C5	04	OPCEL1	JSR	CRONLY	Move Cursor to start of line
	0467	20	D5	04		JSR	READA	Read address
	046A	20	CC	1F		JSR	OPEN	Open Cell (KIM 1FCC)
	046D	A9	20		DISDA	LDA	#$20	
	046F	91	ED			STA	(ED),Y	Print 2
	0471	E6	ED			INC	CURSL	spaces
	0473	91	ED			STA	(ED),Y	on TVT
	0475	E6	ED			INC	CURSL	
	0477	B1	FA			LDA	(Point L),Y	Print current
	0479	20	E4	04		JSR	DISBYT	cell data in next 2 TVT spaces

mode or free-form TV typewriter mode. The AKIM mode is entered by depressing the CTRL and 0 keys (SI). Return to TVT mode is accomplished by depressing delete (DEL) or CTRL and X keys (CAN).

The Back Space function included in AKIM need not be executed to alter the data in the open memory cell. It was only included to provide *neat* listings. When the BS key is depressed while in AKIM mode, the cursor is automatically moved two spaces to the left so that new data can replace the current data displayed. The data is not written into the open cell until the HT or LF keys are depressed.

If the Back Space key is not depressed, the new data will be displayed to the right of the current data in the open cell. Executing HT or LF will cause the two characters (new data) to the left of the cursor to be written into the open cell. Both the previous data and the current data will continue to be displayed.

The Tab function was includ-

Symbol	Address Defined
CURSL	00ED
CURSH	00EE
MODE	00FF
BCKSP	051E
BCKSPA	04B2
CRONLY	04C5
DELETE	0551
DISDA	046D
DISBYT	04E4
DISPT	0514
ENCHA	0542
EXIT	0533
FINISH	052C
GETCON	0438
GOEXC	04B9
HEXTA	04F5
HEXTA1	04FE
HOCUR	053B
LEAVE	0450
NXADR	0496
NXLIN	047F
OPCEL	0460
OPCEL1	0464
PRLIN	04A4
READA	04D5
READD	0503
VTAB	0523
KIM	
INCPT	1F63
PACK	1FAC
OPEN	1FCC

Symbol table.

```
047C  4C  33 05          JMP    "EXIT"          Restore cursor
                                                & RTI
                ;
                ;
                 Open cell at start of
                 next line. Print address
                 and data contents
047F  20  1E 05  NXLIN   JSR    BCKSP           Move cursor left
0482  20  03 05          JSR    READD           Get data from TVT
0485  91  FA             STA    (POINTL),Y      Store data
0487  20  63 1F          JSR    INCPT           In current address
048A  20  C5 04          JSR    CRONLY
048D  20  66 01          JSR    //CURSOR DOWN//
0490  20  14 05          JSR    DISPT           Display Point
0493  4C  6D 04          JMP    DISDA           Display Data
                ; Get data preceding cursor
                ; and store in open cell.
                ; Increment address (open next
                ; cell). Display current data
                ; stored at open cell.
0496  20  1E 05  NXADR   JSR    BCKSP       )   Store
0499  20  03 05          JSR    READD       >   previous
049C  91  FA             STA    (POINTL),Y  )   data
049E  20  63 1F          JSR    INCPT           Incr address
04A1  4C  6D 04          JMP    DISDA
                ; Get data preceding cursor and
                ; store in open cell. Move cursor
                ; to start of line above present
                ; cursor. Open cell at start of line.
04A4  20  1E 05  PRLIN   JSR    BCKSP
04A7  20  03 05          JSR    READD
04AA  91  FA             STA    (POINTL),Y
04AC  20  23 05          JSR    VTAB
04AF  4C  64 04          JMP    OPCEL1
                ; Move cursor left two spaces.
                ; Exit to TVT Scan routine.
04B2  C6  ED     BKSPA   DEC    CURSL
04B4  C6  ED             DEC    CURSL
04B6  4C  33 05          JMP    Exit
                ; Move cursor to start of line.
                ; Get address and jump to
                ; execute program starting at
                ; address displayed.
04B9  20  C5 04  GOEXC   JSR    CRONLY
04BC  20  D5 04          JSR    READA
04BF  20  CC 1F          JSR    OPEN
04C2  4C  C8 1D          JMP    GO EXEC (IDC8)
                ; Carriage return only. Move
                ; cursor full left to start
                ; of current line
04C5  A5  ED     CRONLY  LDA    CURSL           Get cursor
04C7  09  1F             ORA    #$1F            Move to right
04C9  85  ED             STA    CURSL           Restore
04CB  E6  ED             INC    CURSL           Increment
04CD  A5  ED             LDA    CURSL       )
04CF  38                 SEC                }   Move up 1 line
04D0  E9  20             SBC    #$20        )
04D2  85  ED             STA    CURSL           Restore
04D4  60                 RTS
                ; Read address specified by cursor.
                ; Convert from ASCII to hex.
                ; Store in INH & INL
                ;
04D5  A2  04     READA   LDX    #$04
04D7  A0  00     PACK 1  LDY    #$00
04D9  B1  ED             LDA    (CURS)
04DB  20  AC 1F          JSR    Pack
04DE  E6  ED             INC    CURSL
04E0  CA                 DEX
04E1  D0  F4             BNE    Pack 1
04E3  60                 RTS
                ; Display one hex byte in A
                ; as two ASCII characters
                ;
                ;
04E4  85  FC     DISBYT  STA    Temp        )
04E6  4A                 LSR    A           }   Get high
04E7  4A                 LSR    A           >   byte
04E8  4A                 LSR    A           }
04E9  4A                 LSR    A           )
```

```
04EA  20  F5  04          JSR   HEXTA
04ED  A5  FC              LDA   Temp         Get low byte
04EF  20  F5  04          JSR   HEXTA
04F2  A5  FC              LDA   Temp
04F4  60                  RTS
                  ; Convert hex to ASCII and load TVT
                  ; at position defined by cursor
04F5  29  0F      HEXTA   AND   #$0F
04F7  C9  0A              CMP   #$0A
04F9  18                  CLC
04FA  30  02              BMI   HEXTA1
04FC  69  07              ADC   #$07
04FE  69  30      HEXTA1  ADC   #$30
0500  4C  D3  01          JMP   01D3
                  ; Get 2 characters from TVT convert
                  ; to hex and load into INL and A
0503  A2  02      READD   LDX   #$02
0505  A0  00              LDY   #$00
0507  B1  ED      PACK1   LDA   (CURS),Y
0509  20  AC  1F          JSR   Pack
050C  E6  ED              INC   CURSL
050E  CA                  DEX
050F  D0  F6              BNE   Pack1
0511  A5  F8              LDA   INL
0513  60                  RTS
                  ; Get current address and
                  ; display on TVT
                  ;
0514  A5  FB      DISPT   LDA   POINTH
0516  20  E4  04          JSR   DISBYT
0519  A5  FA              LDA   POINTL
051B  4C  E4  04          JMP   DISBYT
                  ; Move cursor left 2 spaces
                  ; and return to calling routine
                  ;
051E  C6  ED      BCKSP   DEC   CURSL
0520  C6  ED              DEC   CURSL
0522  60                  RTS
                  ;
                  ; Move cursor up 1 line
                  ;
0523  20  C5  04  VTAB    JSR   CRONLY
0526  38                  SEC
0527  E9  20              SBC   #$20
0529  85  ED              STA   CURSL
052B  60                  RTS
                  ; Check Mode and return to
                  ; calling routine if MODE 1.
                  ; If Mode 0 return to SCAN.
052C  A5  FF      FINISH  LDA   Mode   }
052E  C9  00              CMP   #$00   } Check Mode
0530  F0  01              BEQ   EXIT   }
0532  60                  RTS                Return to Mode 1
                                             Calling Routine
0533  B1  ED      EXIT    LDA   CURSL  }
0535  09  80              ORA   #$80   }     Restore cursor
0537  91  ED              STA   CURSL  }
0539  68                  PLA                Restore Accum.
053A  40                  RTI                Return to Scan
                  ; Initialize Mode to 0 and
                  ; home cursor
                  ;
053B  A9  00      HOCUR   LDA   00     }
053D  85  FF              STA   FF     }     Clear Mode
053F  4C  47  01          JMP   ///HOME CURSOR///
                  ; Mode 1 character entry. If "DEL"
                  ; reset mode to 0 return cursor to
                  ; start of line and exit. All other
                    characters enter and exit to Scan.
0542  C9  7F      ENCHA   CMP   #$7F         Delete?
0544  F0  0B              BEQ   DELETE       Yes
0546  20  D3  01          JSR   //ENTER CHARACTER//
0549  D0  03              BNE                Screen overflow?
054B  20  75  01          JSR   //SCROLL//   Yes
054E  4C  33  05          JMP   EXIT         No, Exit
0551  20  C5  04  DELETE  JSR   CRONLY       Move Cursor left
0554  A9  00              LDA   #$00   }
0556  85  FF              STA   FF     }     Reset Mode
0558  4C  33  05          JMP   EXIT         Exit to Scan
055B  FF                        END
```

ed for ease of visual editing, so that all the bytes of a single instruction may be displayed on the same line.

Full Memory Usage with TVT

Now that you have an ASCII terminal, it's time to *think* BASIC or Assembler. But since the TVT-6L uses address location 2000 to EFFF, there appears to be no place to put the required memory. Look again! A very minor modification to the TVT-6L and a few simple software instructions allow you to switch between TVT and full-memory access under program control.

Since the input to the Decode PROM (IC3) on the TVT-6L is tied low, the TVT function is enabled anytime addresses 2000 to EFFF are called up. The secret to full-memory access is to turn off the Decode PROM under software control. To do this we need only remove the ground connection on the $\overline{EN}$ input to the Decode PROM (TVT-6, IC3 pin 15) and connect it to an unused peripheral output port on KIM-1, such as PB0 on U3. Fig. 4 shows the necessary modification to the TVT-6L and the addition of 74LS145s for address decoding to high-order RAM.

If you use the TVT-6L PC board, remove the jumper wire connecting IC3 pin 15 to ground and add a jumper between IC3 pin 15 and the unused PC connector pin 5. Add a new wire between the TVT-6L mating connector pin 5 and KIM-1 application connector pin 9 *or* U3 pin 25. Note that a Tri-state buffer (74LS125) is connected between pins 15 and 16 of the TVT-6L board. This allows normal functioning of KIM-1 decode line K0 when the TVT-6L function is disabled. The three remaining sections of the 74LS125 buffer address lines ABI0, ABII and ABI2.

When PB0 is low, the TVT is enabled; when PB0 is high, the TVT is disabled and full-memory access is enabled. Since PB0 is initialized as an input, the pull-up resistor on PB0 will disable the Decode PROM and cause the system to start out in the normal KIM mode. When

starting up, the first step after Reset is to write a 1 into the data-direction register corresponding to U3-PB0 to set it as an output. After this step, insert instructions in your programs to write a 1 in PB0 to leave the TVT mode and to write a 0 in PB0 to return to the TVT mode.

A word of caution: Instructions to enable the TVT Decode PROM must reside below address 2000. When running programs residing at 2000 and up, use a linking routine located in lower pages to enter the TVT mode.

KIM was great, but Don's TVT-6L with AKIM has opened up exciting new possibilities at a cost every KIM owner should be able to afford.■

Notes.

- Light lines are existing KIM-1 & TVT-6L circuits.
- Heavy lines are changes and additions.
- Only portions of KIM-1 & TVT-61 affected by change are shown.
- Pull-up resistors required on outputs of open-collector decoders (74LS145) not shown.
- PB0 = 0, TVT mode.
- PB0 = 1, KIM mode with full memory use.

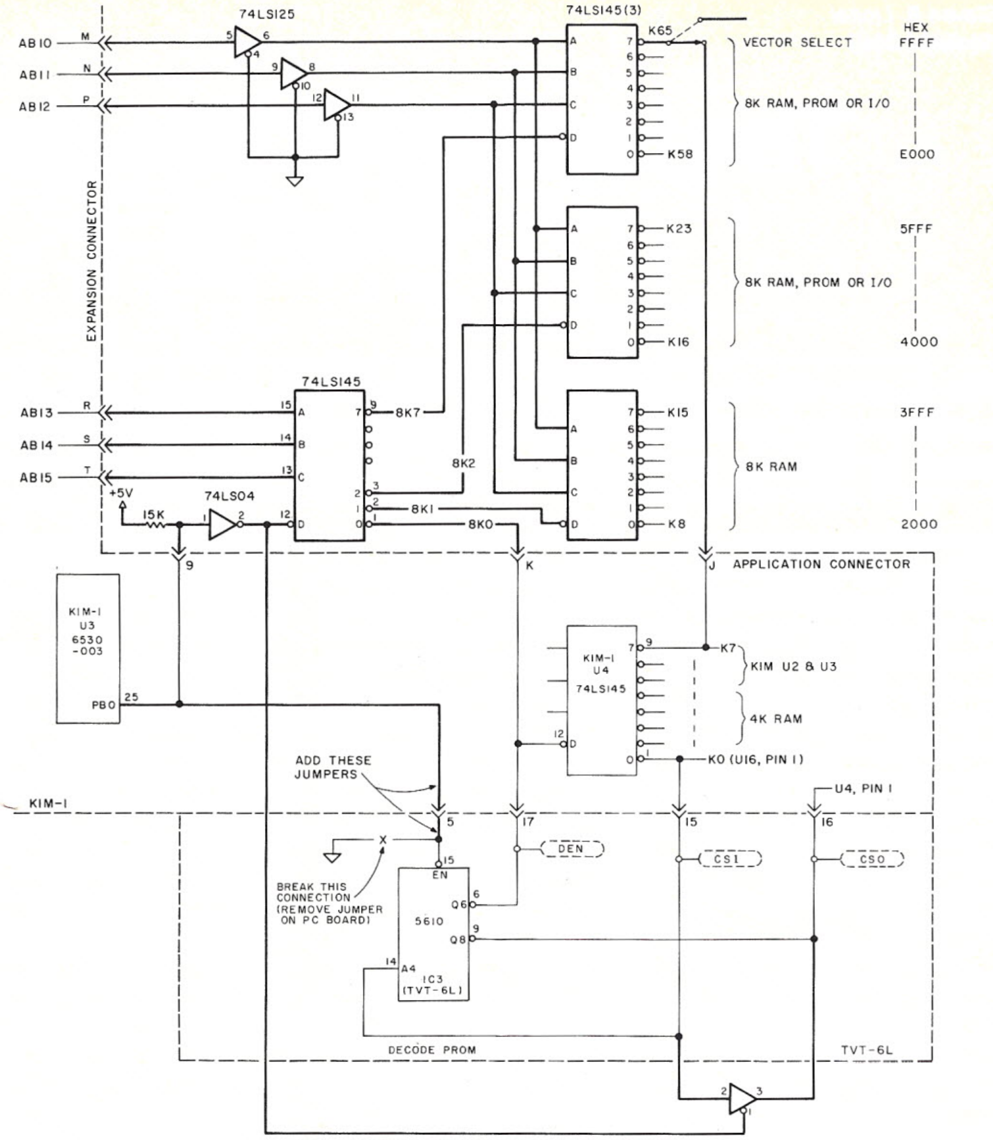


Fig. 4. KIM/TVT-6L memory expansion schematic.

Steven B. Lionel
Kilobaud *Staff*

The Heath/DEC Connection (Part 2)

The H10 is the first low-cost paper tape reader/punch to be introduced for the low-end micro market, and the H9 video terminal certainly falls into the low-cost area—especially when its features are compared with some of the high-price spreads.

Before discussing Heath's new H10 paper-tape reader/punch, I want to touch on the question of "Why paper tape?" Well, the simplest answer is that Heath's floppy disk wasn't ready yet. In general, Heath takes longer than other companies to get items into production because they take great care to make the kits easy to build, and their detailed manuals take a long time to write.

You might wonder why Heath didn't come out with an audio cassette interface as they did for the H8, and as most micro manufacturers have done for their systems. The answer is simple: No Digital software exists for an LSI-11 audio cassette.

Digital's cassettes, like those of most non-hobby manufacturers, use a direct digital recording technique that requires expensive electronics and is unusable on audio recorders. Although Heath could probably have designed an audio cassette interface, they preferred to stick with their policy of keeping the H11 compatible with the existing LSI-11.

Paper tape is an easily distributed media and has only one format, industry-wide (unlike the many cassette "standards"). With paper tape, you can swap programs with owners of many different makes of computers, instead of being limited to a few sources. Also, paper tape is the only available method for H11 owners to obtain software from DECUS, the Digital Equipment Corporation Users Society. More on DECUS later.

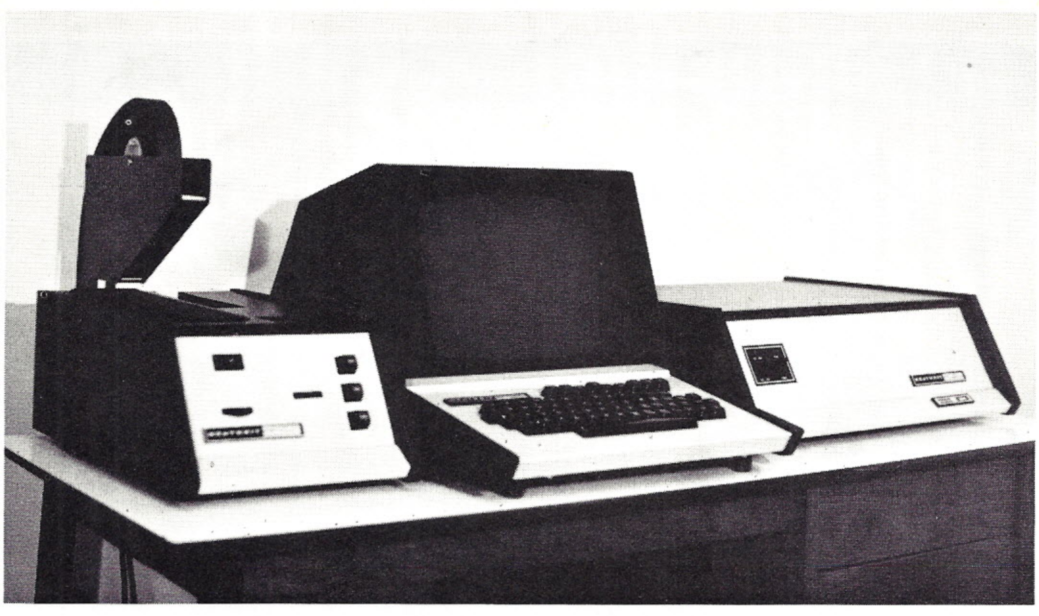
The advantages of paper tape are numerous; are there any disadvantages? Sure! First, paper tape is slow. Most audio cassette interfaces run at speeds between 20 and 120 characters per second (cps). The H10 punches at 10 cps and reads at 50 cps. There are faster devices, of course, but they are also more expensive. Another disadvantage is that paper tape is not reusable. Once the tape is punched, that's it. (This can also be an *advantage* since you will hardly ever "drop a bit" from a punched tape.)

So, the net result is that if you buy an H11 system now, you'll have to run it with the paper-tape I/O. Heath's H10 reader/punch is, of course, designed to go along with Heath's computers, both the H11 and the H8.

The H10 is a punch and reader combined in a single cabinet. The punch section of the H10 is operated by ten solenoids (see photos). Eight solenoids punch the data holes; one punches the index hole; and the tenth advances the tape by means of a ratchet mechanism. The punch is about as noisy as a Teletype ASR 33, but with a minimum of vibration; the cabinet has been designed not to move around at all.

The H10 reader senses the holes photoelectrically and its sensitivity can be adjusted for each data channel individually. This allows you to compensate for the various types of paper tape used; without this feature, you might have trouble reading the less opaque (less expensive) yellow tape commonly used in Teletype punches. The tape is advanced by an ingenious servomotor mechanism that can read one character at a time, unlike most cassettes and many paper tape readers that read lines or even whole files at a time.

Building the H10 is not difficult, although there is a lot of point-to-point wiring that is not done with Heath's usual cable harnesses. The front-panel switches are wired to a terminal strip on the chassis, which is wired to the circuit board. The circuit board is wrapped up in a



A Heath computer system—the H10 paper-tape reader/punch, the H9 video terminal and the H11 computer. All Heath computer products share a handsome cabinet design.

maze of wires that makes it difficult to move, and leaves the fuse hidden beneath the solenoids.

I believe that the H10 may have been rushed to market before getting enough of the careful engineering that shows in most Heath products. However, once built and properly adjusted, the H10 is reliable and should not require frequent service.

It took another *Kilobaud* staff member 23 hours to build and adjust the H10. There is a lot of mechanical work in the assembly, possibly more than electronic work. The hardest part in building the H10, however, is the final adjustment. You must align the punch sprocket so that the hole spacing is precisely ten holes to the inch. This is a painstaking process that can easily take several hours. It cannot be ignored either, for exact adjustment is crucial to proper operation of the H10.

The reader-sprocket adjustment is easier, but still troublesome. The trick here is to have the tape holes stop precisely over the photocells. If this is not done correctly, the data read will be garbled. I found, though, that once adjusted properly, the H10 performed flawlessly, requiring no readjustment.

There are three switches on the front panel that control the H10's operation. One enables and disables the reader, and another does the same for the punch. A third switch feeds tape through the punch while held down. This is a nice feature, but what is really needed is a way to advance the tape in the reader. With the H10, you must either turn off the reader's power and pull the tape through, or use the H11 to run the reader continuously. The lack of a reader feed switch is a serious deficiency.

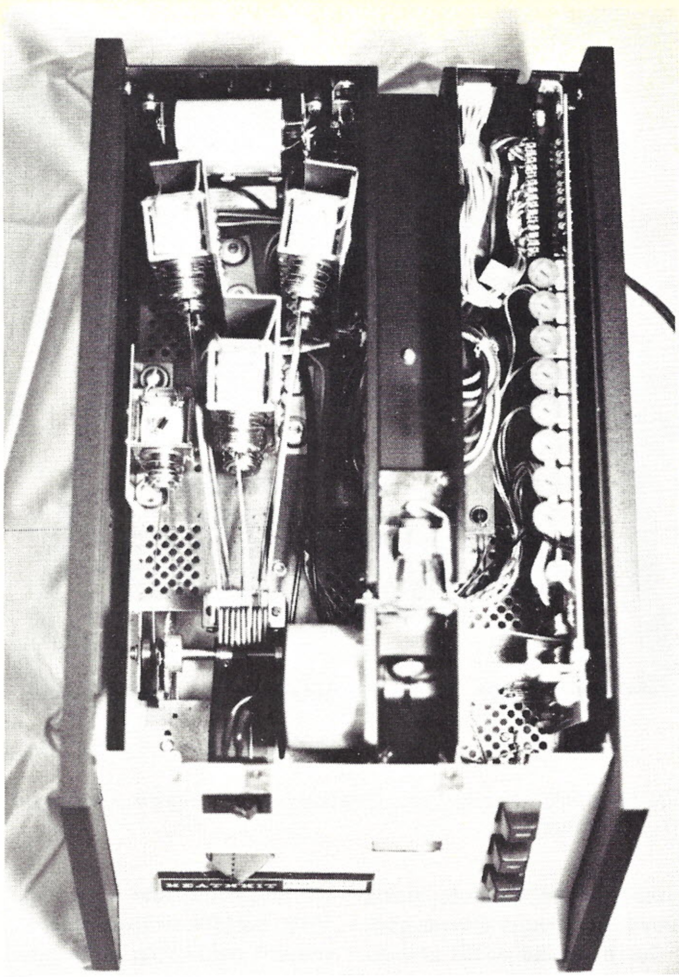
The H10 is not difficult to use, although some aspects of its operation can be tiresome. The punch is designed mainly for roll tape, although fanfold can also be used. The punched tape comes out of a slot on the front of the unit; pulling the tape against a pointed tear bar will produce the usual notch and tab at the end.

Heath supplies a small plastic box to be placed under the punch mechanism to catch the punched tape holes (chad) that fall down. This doesn't work too well because it is difficult to determine where the punch is located in relation to the cabinet while it is setting on a table. On the other hand, if you don't collect the tape chad, it spreads everywhere and is virtually impossible to remove from clothing, rugs, hair, pets, etc.

The reader suffers from the elegant cabinet design. In all paper tape readers I have seen, the entire reader mechanism is exposed so that loading, positioning and unloading tape is easy. Instead, on the H10 you must slide the tape into a slot on top of the machine, being careful not to catch it anywhere. Then slide it under a pressure spring and over the read head. At this point, the tape is again exposed through a two-inch opening where you lift up the sprocket gate and somehow guide the tape over the sprocket, back into the machine, and out another slot. Pactice makes this difficult task a bit easier; so does using the computer to forward-space the tape in the reader.

The H10 has a couple of additional features that can be useful. One is a copy switch that allows easy duplication of tapes without use of a computer, and the other is a switch that compensates for low line voltages. Without this second switch, some heavier tapes might not get completely punched.

The H10 comes with a fanfold tape catcher that you must set on the floor to catch the tape as it spews out of the reader. Too often it is not positioned exactly right so it doesn't work, and you end up with a spaghettiesque mess on the floor. Roll tape provides no advantages here because you have to rewind the tape after each use. Although Heath supplies a 900-foot roll of tape with the H10, I recommend the use of fanfold, since it is easier to store and use.



Inside the H10 paper-tape punch/reader. Punch mechanism with solenoids is on left, reader and circuitry are on right.

The parallel interface in the H10 is, of course, designed to work with the Heath computers. It is also easily connected to any small computer's parallel I/O port. One feature unfortunately missing, though, is a way for the H10 to tell the computer that the reader is empty.

Even with all its negative aspects, the H10 paper-tape reader/punch is an exceptional buy at $350. The H10 brings paper-tape punching down to an affordable price, along with a moderately fast reader, but it could certainly use a bit more work.

H9 Video Terminal

Perhaps Heath's most ambitious project in their computer line, the H9 video terminal offers features that are not found on many terminals costing two or three times more. The H9 has a 12-inch (diagonal) cathode ray tube (CRT) that can display up to 960 characters, either as 12 rows of 80 characters each, or 48 rows of 20 characters each. In addition, there is a plot mode that permits simple graphs on a 128 (high) by 80 (wide) grid.

The H9 has many other features, such as scrolling, cursor-control keys, erase-to-end-of-line and erase-page keys, and a transmit-page key that sends the entire page contents at once. Serial I/O is used to communicate between the H9 and a computer with seven possible baud rates. 110 baud and 300 baud are always switch selectable, along with a third baud rate between 600 and 9600, selected by a jumper. Heath suggests that this last rate be set to 600 baud.

A unique feature of the H9 is a parallel I/O port that is driven by the serial port. Using this, you can connect a parallel device, such as the H10 reader/

The Heath H9 video terminal. Special function keys in a separate row at the top.

punch, to the computer using only the computer's serial port.

There are 64 ASCII characters displayable on the H9, using a 5 x 7 dot grid. A full 67-key ASCII keyboard (uppercase only) is provided along with an end-of-line bell. All things considered, the H9 is a feature-packed terminal at a low price of $530.

The H9 was the only part of Heath's computer system that I assembled (the H10 was built by another staff member, and the H11 was loaned to us preassembled by Heath). I took about 25 hours over a few weeks and had very little trouble, except when I didn't follow directions!

There are six circuit boards in the H9, although one is already assembled and tested. There is a small amount of point-to-point wiring involved, with most interconnections being through a large and complex cable harness. Most of the circuit boards are solder-masked, and some are double-sided to cut down on jumpers. One board, though, (the keyboard) was single-sided and required numerous jumpers, an annoying task. Assembly of the H9 is smooth and easy, with tests performed frequently to prevent destroying parts later on.

In operation, the H9 provides a clear and crisp display with only a little fuzziness evident at the edges. The keyboard does not have the feel of a commercial terminal and tends to exhibit key bounce, but it is quite adequate. My major gripe here is that the return key is the same size as the rest of the keys and is not on the edge, which takes some getting used to.

The plot mode, mentioned above, is interesting. When the plot key is down, what would normally be the top line of the display is written four times on the bottom four lines. Above each character is an underline, plotted at a height determined by the ASCII value of the character beneath it.

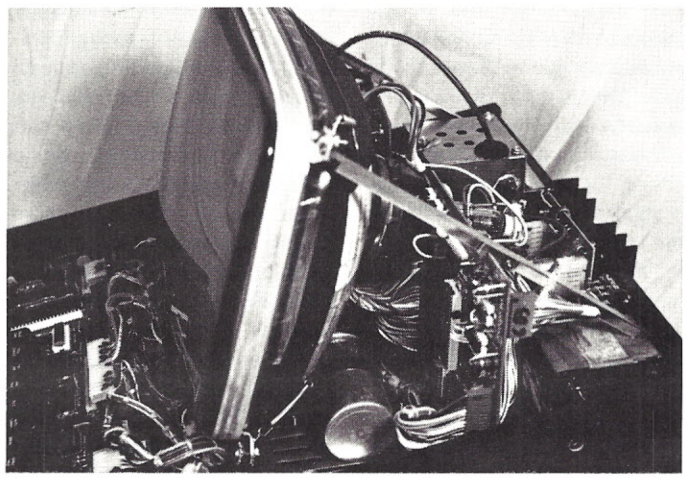
Therefore, a NULL (ASCII 0) is plotted lowest and a rubout (ASCII 128_{10}) is plotted highest. Since 80 characters are displayed on a line, a simple single-line graph of 80 points can be displayed.

The other unusual display mode of the H9 is the "short-form" mode. When the short-form switch is down, the screen is considered to be 48 lines of 20 characters each, arranged in four columns. Advancing from the bottom of the rightmost column shifts the display left one column. The end-of-line bell works in "short form" too, ringing when there are seven characters left in the line. Short form can be useful for examining many short lines, for example, in an assembler program.

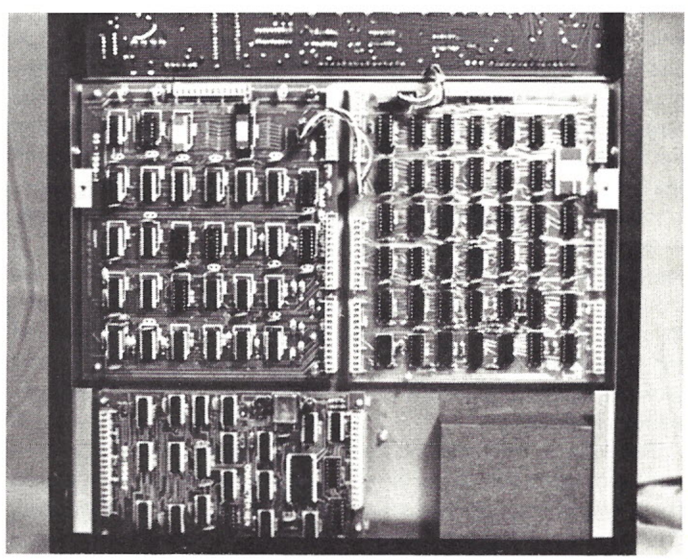
Perhaps the greatest shortcoming of the H9 is the complete lack of computer control over cursor movement and screen clearing. Most hobbyist terminals have a means by which the screen can be cleared by a single command from the computer, and some also allow the cursor to be moved without disturbing the display. This may be a turn-off for some hobbyists who want some sort of display-update for games and other uses.

Warranties and Service

Heath claims that they "will never let you fail." This seems to be true, for with a combination of the profuse documentation and Heath's superb technical assistance available by phone, I easily solved every problem I encountered while building and/or testing the H9,



The H9 terminal from the top. I/O interface, power supply and video driver board are visible. Use of preassembled cable harness cuts down on construction effort.



Major circuitry of the H9 is on bottom of unit. Clockwise from bottom—character generator, RAM and counter board and preassembled "terminal processing unit" board.

H10 and H11. I want to especially commend the technical people at Heath who always seemed to have the correct answer at their fingertips and were never rude or brusque. In fact, without them, I would still be puzzling out parts of the system.

Heath has a 90-day full warranty on all parts, assuming you didn't do something foolish like use acid-core solder. In addition, Heath offers a one-year service contract on the H11 CPU board for $25. I highly recommend this, as Digital's field service charges $43 an hour (minimum two hours) for any service performed. The LSI-11 is reliable, but the $25 is insurance money well spent.

DECUS

One of the most useful features of the H11 is the opportunity for owners to join DECUS, the Digital Equipment Corporation Users Society. DECUS is independent of Digital and offers its members access to a vast library of programs for every computer that Digital sells. The programs that can be used on the H11 are offered on paper tape; most sell for only $2 each. The software is "as is," however, and comes from submissions by members. This may mean that bugs still exist in the programs; if detected, they're yours to fix.

Some programs are useful, such as a combination assembler and editor and an improved BASIC. In fact, some of the software supplied with the H11 originated in DECUS, and was later adopted by Digital. There are the usual games, and many special purpose programs useful to only a few people; but in general DECUS membership is worth having. A membership application is included with each H11.

Conclusion

Heath has put a lot of effort into their computer line, and it shows. Each item is a quality product with many years of experience behind it. Heath has numerous retail outlets, each with knowledgeable service personnel and a capable assistance team in Benton Harbor. A Heath computer system will surely prove a good investment.

In a future article for *Kilobaud*, I will discuss the H11 software in detail, with special emphasis on BASIC. ■

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Depreciation Calculations

Here's still another useful set of programs to add to your small-business system. It's doubtful that we'll ever run out of such routines to add to business systems.

John Musgrove
9547 Kindletree Dr.
Houston TX 77040

Most businesses, large or small, have capital assets that they need to depreciate for a period of five to 20 years. The depreciation is a tax deduction permitted by the federal government to allow a business to save the reduced taxes for the future replacement of the used asset.

Straight Line Depreciation (Program A) calculates a monthly depreciation value for an asset based on the straight-line method. This method is so called because a graph of the depreciated value versus the depreciation period is a straight line. It is, in effect, an average depreciation which is constant for all periods. To eliminate output problems due to errors in rounding to two decimal places, this program rounds the average depreciation to the nearest cent and saves and accumulates any fractions of a cent for addition

```
D(I) = the depreciation in month I

V(I) = the remaining asset value in month I

C = the asset's initial value

M = the total depreciation period, in months

D1 = the monthly depreciation

D = the monthly depreciation, rounded to two decimals

N = M - 1
```

Table 1. Variables in Program A.

```
10 REM STRAIGHT LINE DEPRECIATION PROGRAM BY JOHN MUSGROVE
20 REM FEBRUARY 5, 1978
30 PRINT"STRAIGHT LINE DEPRECIATION WILL CALCULATE THE MONTHLY"
40 PRINT"DEPRECIATION AND REMAINING VALUE OF AN ASSET HAVING"
50 PRINT"AN INITIAL VALUE 'C' AND A DEPRECIATION PERIOD OF"
60 PRINT"'M' MONTHS."
70 PRINT
80 DIM D(121),V(121)
90 PRINT
100 INPUT"ASSET INITIAL VALUE = ? ",C
110 INPUT"DEPRECIATION PERIOD IN MONTHS = ? ",M
120 PRINT
130 PRINT"MONTH    DEPRECIATION          VALUE"
140 D(0) = 0
150 V(0) = C
160 PRINT"   0";TAB(4);%C$10F2,D(0);%C$14F2,V(0)
170 D1 = C/M
180 D = INT(D1*100)/100
190 N = M - 1
200 FOR I = 1 TO N
210 D(I) = D
220 V(I) = V(I-1) - D
230 NEXT I
240 D(M) = C - (N*D)
250 V(M) = V(N) - D(M)
260 FOR J = 1 TO M
270 PRINT %4I,J;TAB(4);%C$10F2,D(J);%C$14F2,V(J)
280 NEXT J
290 END
```

Program A. Straight Line Depreciation program.

```
STRAIGHT LINE DEPRECIATION WILL CALCULATE THE MONTHLY
DEPRECIATION AND REMAINING VALUE OF AN ASSET HAVING
AN INITIAL VALUE 'C' AND A DEPRECIATION PERIOD OF
'M' MONTHS.
ASSET INITIAL VALUE = ? 25ØØ
DEPRECIATION PERIOD IN MONTHS = ? 24

MONTH   DEPRECIATION      VALUE
  Ø         $.ØØ        $2,5ØØ.ØØ
  1       $1Ø4.16       $2,395.84
  2       $1Ø4.16       $2,291.68
  3       $1Ø4.16       $2,187.52
  4       $1Ø4.16       $2,Ø83.36
  5       $1Ø4.16       $1,979.2Ø
  6       $1Ø4.16       $1,875.Ø4
  7       $1Ø4.16       $1,77Ø.88
  8       $1Ø4.16       $1,666.72
  9       $1Ø4.16       $1,562.56
 1Ø       $1Ø4.16       $1,458.4Ø
 11       $1Ø4.16       $1,354.24
 12       $1Ø4.16       $1,25Ø.Ø8
 13       $1Ø4.16       $1,145.92
 14       $1Ø4.16       $1,Ø41.76
 15       $1Ø4.16         $937.6Ø
 16       $1Ø4.16         $833.44
 17       $1Ø4.16         $729.28
 18       $1Ø4.16         $625.12
 19       $1Ø4.16         $52Ø.96
 2Ø       $1Ø4.16         $416.8Ø
 21       $1Ø4.16         $312.64
 22       $1Ø4.16         $2Ø8.48
 23       $1Ø4.16         $1Ø4.32
 24       $1Ø4.32           $.ØØ
```

Fig. 1. Sample run of Program A.

1Ø - 7Ø	Remarks and introduction
8Ø	Dimension the two variables
1ØØ & 11Ø	Input data
13Ø	Print the column headings
14Ø & 15Ø	Set initial values of variables
16Ø	Print the data for month Ø. D(I) and V(I) are printed with formatted outputs. % indicates a formatted output, C adds appropriate commas, $ adds a "$" sign, 1ØF2 means print a 1Ø column field with two decimal places, right justified.
17Ø & 18Ø	Calculate the depreciation amount and round it off.
19Ø	Set limit for the calculation loop
2ØØ	Open calculation loop
21Ø	Calculate each month's depreciation
22Ø	Calculate each month's remaining value
23Ø	Close calculation loop
24Ø & 25Ø	Calculate the final values of D and V
26Ø	Open the printing loop
27Ø	Print the data. %4I is a 4-character field of integer data, right justified.
28Ø	Close the printing loop
29Ø	End

Table 2. Description of the elements in Program A by line number.

V = the remaining value in year J, initially the new value

N = the total depreciation period, in years

J = the year for which a calculation is being made

D = the depreciation in year J

Table 3. Program B variables.

to the final period's depreciation.

Maximum Annual Double Declining Depreciation (Program B) calculates an annual depreciation value based on the double declining method. This method allows each period's depreciation to be twice that which it would be using the straight line method with the original number of periods and the depreciated remaining value of each period.

Once the double declining depreciation becomes less than that obtained by depreciating the remaining value by the straight-line method for the remaining

```
MAXIMIZE ANNUAL DOUBLE DECLINING DEPRECIATION WILL
CALCULATE THE AMOUNT OF DEPRECIATION 'D' FOR EACH
YEAR FOR 'N' YEARS.  ONCE THE DEPRECIATION BY THE
DOUBLE DECLINING METHOD IS LESS THAN THAT OBTAINED
BY THE STRAIGHT LINE METHOD THE PROGRAM AUTOMATICALLY
CHANGES TO STRAIGHT LINE.
ASSET INITIAL VALUE = ? 1ØØØØØ
NUMBER OF YEARS = ? 1Ø

END OF YEAR    DEPRECIATION     CURRENT VALUE

     1          $2Ø,ØØØ.ØØ       $8Ø,ØØØ.ØØ
     2          $16,ØØØ.ØØ       $64,ØØØ.ØØ
     3          $12,8ØØ.ØØ       $51,2ØØ.ØØ
     4          $1Ø,24Ø.ØØ       $4Ø,96Ø.ØØ
     5           $8,192.ØØ       $32,768.ØØ
     6           $6,553.6Ø       $26,214.4Ø
     7           $6,553.6Ø       $19,66Ø.8Ø
     8           $6,553.6Ø       $13,1Ø7.2Ø
     9           $6,553.6Ø        $6,553.6Ø
    1Ø           $6,553.6Ø            $.ØØ
```

Fig. 2. Sample run of Program B.

```
10 REM MAXIMIZE ANNUAL DOUBLE DECLINING DEPRECIATION
20 REM BY GORDAN MUSGROVE, FEBRUARY 5, 1978
30 PRINT"MAXIMIZE ANNUAL DOUBLE DECLINING DEPRECIATION WILL"
40 PRINT"CALCULATE THE AMOUNT OF DEPRECIATION 'D' FOR EACH"
50 PRINT"YEAR FOR 'N' YEARS.  ONCE THE DEPRECIATION BY THE"
60 PRINT"DOUBLE DECLINING METHOD IS LESS THAN THAT OBTAINED"
70 PRINT"BY THE STRAIGHT LINE METHOD THE PROGRAM AUTOMATICALLY"
80 PRINT"CHANGES TO STRAIGHT LINE."
90 PRINT
100 INPUT"ASSET INITIAL VALUE = ? ",V
110 INPUT"NUMBER OF YEARS = ? ",N
120 PRINT
130 PRINT"END OF YEAR","DEPRECIATION","CURRENT VALUE"
140 PRINT
150 LET J = 0
160 LET D = (2/N)*V
170 LET V = V - D
180 LET J = J + 1
190 PRINT %5I,J;TAB(11);%C$10F2,D;%C$15F2,V
200 IF J = N THEN 240
210 IF D > (V+1)/(N-J) THEN 160
220 LET D = V/(N-J)
230 IF J <= (N-1) THEN 170
240 END
```

Program B. Maximize Annual Double Declining Depreciation program.

10 - 90	Remarks and introduction
100 & 110	Input data
130	Print column headings
150	Set the year of calculation to 0
160	Calculate the current depreciation
170	Calculate the current remaining value
180	Increment the year of calculation
190	Print data
200	Check for the current year being the final year
210	Check that double declining depreciation still greater than straight line method
220	Calculate straight line depreciation
230	Check for the current year being the final year
240	End

Table 4. Description of the elements in Program B by line number.

periods, the program automatically switches to the straight line method. The advantage of the double declining method is that faster tax write-offs are allowed during the initial years when a company most needs the tax break this method offers.

The programs were written using Digital Group's Maxi-BASIC. ■

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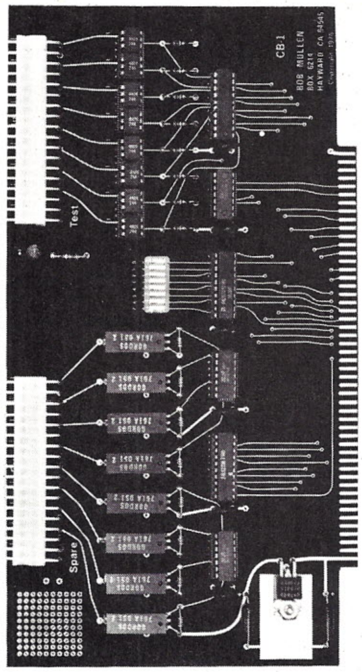

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Not So Tiny

Tiny BASIC is the favorite higher-level language of many microcomputer users. Here is one technique for overcoming Tiny's lack of FOR/NEXT loops.

KIM-1 and KIM-2 in redwood enclosure, ACT-1 TVT, Telpar Printer, Computerist power supply, Radio Shack recorders.

```
:LIST

10 REM   ORIGINAL VERSION
11 REM
100 FOR Y=1 TO 10
110 LET C=0
120 FOR X=1  TO 50
130 LET F=INT(2*RND(1))
140 IF F=1 THEN 180
150 PRINT "T";
160 GOTO 200
170 REM   C COUNTS NO OF HEADS
180 LET C=C+1
190 PRINT "H";
200 NEXT X
210 PRINT
220 PRINT "HEADS    ";C;"    OUT OF 50 FLIPS"
230 NEXT Y
240 END
```

Listing 1.

Programs written in Tiny BASIC and other small interpreters can be useful and fun. First, some changes in programming techniques and philosophy are needed, though, because there are fewer statements and commands in small interpreters.

One basic and very useful programming tool is the loop. Several articles have been written about the power and use of loops properly written and executed in a program. Usually in larger BASICs, these loops are written with FOR-NEXT statements. In Tiny BASIC, the equivalent statements are LET, IF . . . THEN GOTO.

To illustrate the conversion of FOR-NEXT statements to LET, IF . . . THEN GOTO statements, I have used the program in Listing 1. This is a coin-flipping routine with one counting loop inside another. The outside loop resides between lines 100 and 230; the inside loop is between lines 120 and 230. Lines 10 and 11 are my comment and are not part of the original program. It is not possible to run this program on my system because the Tiny BASIC interpreter would not recognize line 100 and would stop.

Listing 2 is my version rewritten in Tiny BASIC. I have added a couple of features, such as the INPUT N line, which lets you select N sets of 50 flips. Also, I like to see DONE (or something) at the end of a program. This way I know the program didn't quit in the middle (if the algorithm was right, anyway). Otherwise, Tiny BASIC used two more program lines than the larger BASIC version.

In my program, the two main loops comparable to the sample program are started with a LET statement. The outside loop is between lines 110 and 250 and controls the number of passes of 50 flips set in line 100. The inside loop is between lines 130 and 210 and controls the number of flips set in line 210. As I stated there are two additional lines—the counters for the two loops. The loop counter in line 200 increments by one on each pass through the program until it reaches the values in line 210. Incrementing the I loop (in line 240) by one occurs until the value in line 250 is reached. In this case, I is compared to N, the value input in line 100. The value of N lets the user select how many sets of 50 flips are to be run by the program before it ends.

Coin flipping, counting and printing are handled in lines 140 to 190. Line 140 randomizes the number 2 (1 is added so there are no zeros). If the random number is 1, it becomes a "head" and passes to the head counter in line 180. The head counter increments by one and prints an H, then increments the X loop by one. If X is less

than the limiting value (50), the program returns to the flip routine at line 140 and starts through again.

If F does not equal 1 in line 150, the value becomes a "tail," a T is printed, X is incremented (by jumping to line 200) and compared to the limiting value. This time, if 50 flips have occurred, the program falls through to the print statement in line 230. Heads (C) counted in line 180 are printed out and the program tests the relationships in lines 240 and 250. When I > N, the program prints DONE and ends.

Tiny BASIC, even though small in size, has power enough to produce significant programs. Applications are limited only by your imagination and user space in your computer's memory. In addition to some tricks using implied statements and commands to save memory, I have written programs to plot a graph, do simple graphics, do some limited data processing and simulate assembly processes in a small manufacturing company.

I plan to try several potential capabilities that include use of the USR function to save and load from a cassette tape. I would like to share my ideas with anyone interested, and I believe *Kilobaud* would be happy to publish programs for the development of a Tiny BASIC software library.■

```
:LIST
10 REM  TINY BASIC FOR KIM-1
11 REM  6502 V.IK BY T. PITTMAN.
12 REM
13 REM  PROGRAMED BY:
14 REM  C. R. (CHUCK) CARPENTER W5USJ
15 REM  2228 MONTCLAIR PL.
16 REM  CARROLLTON, TX. 75006
17 REM
18 REM  FLIPS A COIN 'N' TIMES 50 AS SELECTED
19 REM  IN LINE 100, THEN PRINTS THE NUMBER OF
20 REM  HEADS IN EACH 50 FLIPS.
21 PR
22 PR
100 INPUT N
110 LET I=1
120 LET C=0
130 LET X=1
140 LET F=(RND(2)+1)
150 IF F=1 GOTO 180
160 PRINT "T";
170 GOTO 200
180 LET C=C+1
190 PRINT "H";
200 LET X=X+1
210 IF X<=50 GOTO 140
220 PRINT
230 PRINT "HEADS    ";C;"   OUT OF 50 FLIPS"
240 LET I=I+1
250 IF I<=N GOTO 120
260 PRINT
270 PRINT "DONE"
280 END

:RUN
? 5
HTTHTTTHHTHHTTTTHHHHHHTHHHTHTHHTTTHHTTHHTTTHHTHTTH
HEADS  26  OUT  OF  50  FLIPS
HHTHHHTHHHHHTTHTTHHTTHHTHHTTTTHHTHHHTHTHTHTTTTTHHH
HEADS  28  OUT  OF  50  FLIPS
TTHHTTTHHHHTTTHHTHHHHHHTHTTHTHHTHHTHHHHTHHTHTTTTTHHH
HEADS  28  OUT  OF  50  FLIPS
THTHHHHTTTTHTTTTTHTTTTHHHTHTHTHHHHHHTTTTHTHHHTHTHH
HEADS  25  OUT  OF  50  FLIPS
TTHTTHHTTTTTTTTHTTHTHTTTTHTTTHTTHHHTTHTHHTHTHTHTHT
HEADS  18  OUT  OF  50  FLIPS

DONE
```

Listing 2.

KILOBAUD KLASSROOM NO. 13

I/O Circuitry

In the first of two sessions on input/output, we begin a discussion of how our computer communicates with the outside world.

Peter A. Stark
PO Box 209
Mt. Kisco NY 10549

In the last two sessions, we looked at computer memories from two different points of view. First, we looked at them from the side of the microprocessor—how they are organized; how they connect to the data and address buses; and how they are addressed and selected. Then we looked at the individual memory ICs to get an idea of what is inside them and how they work.

Now we will look at computer input/output (I/O) circuitry from the same two viewpoints.

Fig. 1 shows how a typical I/O device connects to a microprocessor. The connection is through an I/O interface, which matches the signals from the microprocessor with the signals from the I/O device.

This interface has two parts: One part has to be designed so that it works in conjunction with the data, control and address buses used in the computer; the other part has to be tailored to fit whatever data and control signals the I/O device needs. The connection at the device side of this interface is often called a *port*.

This month and next month we will examine the right-hand side of the interface and its connections with the I/O device. After that, we will look at the left side of the interface and its connection to the microprocessor. In fact, we'll find that in many microprocessor ICs the interface is actually within the processor IC.

Introduction

There is such a variety of I/O devices that it's hard to describe them in any kind of sensible order. We can lump them into two general groups—intelligent and dumb. An intelligent I/O device is one that has enough of its own logic so that it controls its own operation and timing, and connects with the microprocessor only for the purpose of sending data to or from it. A dumb I/O device, on the other hand, relies on the microprocessor for its operation—it cannot operate by itself. (Don't confuse this use of the word "dumb" with one of the CRT terminals, which is often advertised as the Dumb Terminal. In our context, that terminal would fall in the intelligent class.)

An intelligent I/O device might have a fairly complex interface; whereas a dumb device would be tied very closely into the data, control and address buses, and therefore not have much of an interface.

A good example is the common alphanumeric keyboard. (Here the word alphanumeric means not only alphabetic characters (letters) and numbers, but also includes punctuation marks.) This kind of a keyboard has around 50 keys, which are used for entering numbers or words into the computer.

Most of the keyboards used today are of the intelligent type. When you press a key, the keyboard circuits determine which key has been pressed, check that there are no others pressed at the same time, wait a few milliseconds to make sure that the key closure is real and not just a burst of noise and then generate a six- or seven-bit binary code, which is unique for the key pressed. That code is then sent to the microprocessor. The circuitry for this is fairly complex, but there are several ICs that simplify the job by doing it all with just one IC and a few resistors and capacitors.

With a dumb keyboard, on the other hand, all of this work—checking for other keys, waiting for noise bursts to disappear, generating the appropriate code, etc.—is done by the microprocessor. The keyboard connects to the address and data buses in such a way that a unique data pattern is generated for every key closure, and the rest of the work is done by the microprocessor. This approach, for example, is taken by the Radio Shack TRS-80 microcomputer. Though some additional programming and time is taken up generating the appropriate keyboard output in this way, it is cheaper.

This approach is popular for another reason as well: It makes it harder to connect I/O equipment from a competitive manufacturer. Because it is nonstandard and tightly woven into the programming used by the system (since the microcomputer programs do some of the work of the I/O device), changing to a different I/O device is a major job. One of the larger computer manufacturers has often been accused of doing this very thing.

Another way of looking at I/O devices is to examine the kind of data they use and how it is sent back and forth. I/O data falls into these three types:

1. Single, independent bit data
2. Multiple bits sent in parallel
3. Multiple bits sent in serial

Single, independent bit output data might be used, for instance, with a computer that controls a relay, which in turn controls a light. A single input bit might come from an external switch that is monitored by the computer to sense some external event.

Parallel or serial data is used when more complex information is transmitted. In most cases, this involves a multiple-bit pattern, which carries coded letters, numbers or punctuation marks. When all bits of the code for a single letter are sent together over parallel wires, we have parallel data transmission. When they are sent one after another over the same wire, then we have serial data.

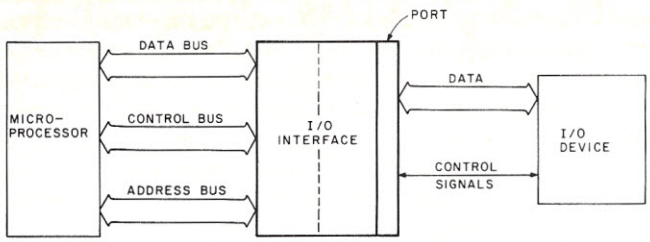


Fig. 1. How an I/O device connects to a microprocessor.

Keep in mind, though, that when several single, independent bits are sent together at the same time, we have something that looks like parallel data. If, for instance, a computer were used to control eight lights in different parts of the house at the same time, we would consider this parallel multiple-bit data, even though eventually it is separated into eight independent bits.

Experiment #61
A One-Bit Output Device

Problem: Suppose we want to control a light bulb from the computer. How do we do it?

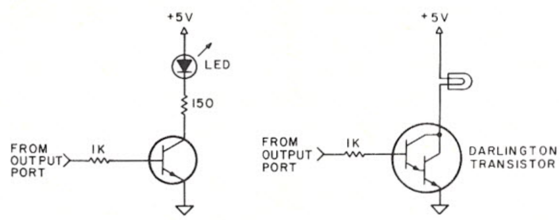
Solution: Let's assume that we already have some kind of interface that will provide a digital output resembling TTL levels at an output port. (How you do that is something we'll leave for next time.) What we need is a circuit to take this signal and amplify it up to whatever voltage and current level is needed to operate that bulb.

Theory: If the light requires very low power—such as a low-wattage miniature bulb or a light-emitting diode (LED), then one of the direct drive circuits of Fig. 2 will work perfectly well.

Fig. 2a shows a single transistor circuit that can provide output currents of a few tens of milliamperes, depending on the transistor. If the output port can supply an output current of, say, half a milliampere, and the transistor has a current gain (beta) of 50, then the load current could be as much as 25 mA (.5 times 50). This would be enough for an LED or perhaps for a small bulb.

If more current is needed, then using a Darlington transistor as in Fig. 2b will provide it. A Darlington transistor is simply two transistors connected as shown, with the emitter of the first driving the base of the second. Two separate transistors could be used, or a commercially made Darlington transistor with two transistors in the same case would work as well.

Although a Darlington circuit actually consists of two separate transistors, it behaves very much like a single transistor of very high gain. Thus, very often the Darlington circuit is shown on diagrams as just a single transistor and is referred to as "a Darlington transistor" as if it is only one.



(A) SINGLE TRANSISTOR DRIVER

(B) DARLINGTON TRANSISTOR DRIVER

Fig. 2. Direct drive circuits to control a light.

The current gain of a Darlington is approximately equal to the product of the gains of the two transistors. Hence if the transistors each had a beta of 50, then the total gain would be 2500. A port current of 0.5 mA could then drive a bulb drawing 1250 mA, or 1.25 ampere.

A current of 1.25 amperes could provide a decent amount of light, but it would not be wise to draw that much current from the regulated +5 volt line just to light a bulb. Why not use a 12 volt bulb and connect the top to a +12 volt power supply? Better yet, why not use a 120 volt bulb and connect the top end of the circuit to a 120 volt power supply? Let's see . . . 120 volts times 1.25 amperes is 150 Watts! That should supply a whale of a lot of light!

This is the point where we can get into a lot of trouble. Suppose something happened to that Darlington transistor—a base-collector short or an emitter open. Now that full 120 volts would be applied through the transistor, back into the output port. This would probably blow the output IC. If that blew just right, it would feed the 120 volts back into the next IC . . . and the first thing you know, you would have a lot of burned-out ICs. That smarts.

What we have to do is isolate the load from the computer so we can still control it, but any fault currents or voltages must not get back into our expensive logic circuitry to cause damage. Fig. 3 shows one possible way of doing this with a relay.

A relay is a mechanical switch, whose contacts are moved by an electromagnet. In this case, we place the coil (the electromagnet) in series with the controlling transistor and control the coil current by turning the transistor on and off with a current from the output port. The relay contacts then control whatever load we have.

You'll notice one extra component here—a diode across the relay coil. This diode is connected so that its cathode goes up to the positive voltage supply. Thus, in normal operation it is reverse biased and will not conduct. Its purpose is to protect the transistor when the relay opens.

To open the relay, we must turn off the coil current. This is similar to opening the points in series with the ignition coil of a car—it generates a high-voltage spike. In a car this is desirable because we need a spark in the spark plug. Here we don't want it because a spark inside the transistor case is the last thing we need. The purpose of the diode is to short out this high-voltage spike to prevent a spark.

In practice, we find that small relays that require a low enough coil current to work in this circuit tend to also have small switch contacts that cannot handle very large current; in this case we would be limited to currents around 1 ampere. This is sufficient for most purposes, but if we needed more current then we could use the contacts of this relay to control a second relay or a high-power semiconductor such as a silicon-controlled rectifier or triac.

Though a relay circuit is a perfectly good idea, many times we do not want to use such a big, slow and expensive device. In many computers, isolation is handled by a device called an opto-isolator or optical coupler.

Fig. 4 shows the pin-out of the 4N33 coupler, a popular device among computer manufacturers. It comes in a six-pin dual in-line package. It consists of a small, sealed and light-tight package that contains a light source and a light detector coupled together so that the light generated by the source shines on the detector.

The 4N33 coupler uses an LED for the light source and a photo-transistor for the detector; other couplers may use incandescent bulbs or even neon bulbs for the light source and cadmium sulfide cells, photodiodes or light-activated silicon-controlled rectifiers for the detector. Each of these obviously has different characteristics and different uses, and the LED/photo-transistor combination is probably the most

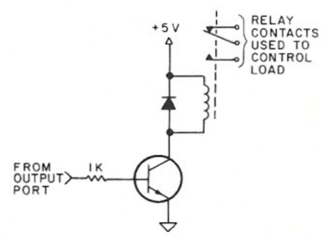


Fig. 3. Controlling a load with relay isolation.

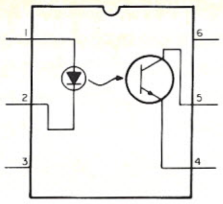


Fig. 4. Pin-out of a 4N33 optical coupler.

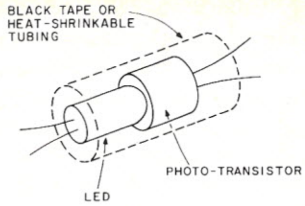


Fig. 5. How to make your own optical coupler.

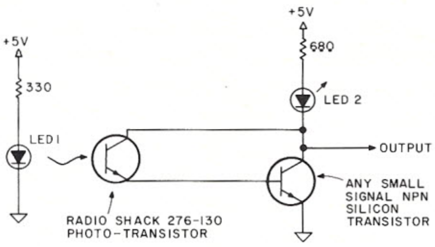


Fig. 6. Experiment #61 circuit.

popular. (Although not shown in Fig. 4, the photo-transistor in the 4N33 is actually a Darlington pair of transistors, which is used to provide larger output currents with smaller inputs.)

As you can see in Fig. 4, the photo-transistor has no base connection. In the dark, this transistor has no base current and therefore appears like an open circuit.

The purpose of the base lead is normally to introduce some current into the base-emitter junction to start a current flowing through the transistor. But when the transistor is exposed to light, the energy of the light does the same thing—it releases some free electrons in the base, fooling the transistor into thinking there is some base current. Thus the light causes the transistor to conduct just as if a base current had been applied. This turns the transistor on so that it behaves like a closed switch.

So we have here a circuit that turns on a transistor when there is a current through the LED. This can be used to couple a digital (or even an analog) signal from one place to another.

But the big advantage is that the LED and the photo-transistor do not touch inside the case. They are separated by a transparent insulator, so that there is absolutely no electrical connection between the two. Most couplers can withstand 500 or 1000 volts between their input and output leads, and some can handle several thousand without the insulation breaking down. Thus, they couple a signal from one place to another while still acting as a good isolator.

This is what we need to protect our fragile computer-integrated circuits from possible damage by external high voltages. In fact, optical couplers are often used simply to reduce noise.

For example, in a computer system used in a factory to control heavy machinery, there is often enough electrical noise around the motors, valves and other mechanical devices that it tends to sneak back into the computer along virtually any direct connection and introduce enough noise into the computer to cause problems. Optical couplers are often used on both input and output leads to isolate them from the heavy machinery and let desired signals through without letting the noise get through as well.

In many ways, the optical coupler behaves like a relay. In a relay, when a current passes through the coil, a set of contacts closes to conduct current. Here, when a current passes through the LED, the photo-transistor turns on to conduct a current.

The optical coupler cannot handle as large a current as even a small relay can, but it is much smaller, cheaper and faster. Even a fast relay cannot operate faster than perhaps 50 or 100 times a second; optical couplers can operate at rates of thousands of times a second, and very fast ones go into the millions of operations a second. And the limited current handling capacity of the optical coupler is no problem, as we can increase the current by adding a transistor or other device to the output.

Procedure: To experiment with an optical coupler, we first have to get one. They are not expensive—costing in the range of one to two dollars—but they are not likely to be in stock at your local electronics store, unless you are lucky enough to live around the corner from a place like James or Jade. So let's make one.

You already have some LEDs, so you need a photo-transistor. Actually, all transistors respond to light to some extent, so what we need is a transistor with a clear case. However, unless you have a European glass transistor with a painted case (and scrape off the paint), you will have to buy a photo-transistor. Radio Shack's 276-130 for 79 cents is a good bet and easily obtained.

Both your LED and the Radio Shack photo-transistor have their lenses on the end of the case, so the two will have to be attached end-to-end as in Fig. 5.

Start by identifying the three leads of the photo-transistor. Like a normal transistor, this one has base, emitter and collector leads; but the base lead is provided for testing and is not needed. Simply cut it off right at the bottom of the case (making sure to cut off the right lead, right?).

Now cover the remaining leads on the transistor and the LED with plastic tubing and make a note as to which is which so you'll recognize them later.

The easiest way to attach the two together is with a short length of heat-shrinkable tubing; if you have some of this very handy material, slip the two in and then shrink it with a little heat. Alternatively, you might simply wrap them with some black electrical tape. Don't use clear cellophane tape, as you want to keep external light out of the package. Though a little glue will help to hold them together, it is probably not needed and will ruin the LED and photo-transistor for further use.

Now bend the leads carefully so that you can plug this assembly into the breadboarding socket on your console and wire up the circuit of Fig. 6.

Like the popular 4N33 coupler, we are also using a Darlington amplifier to give greater current gain. The second transistor can be any small signal NPN silicon transistor such as a 2N2222A; the precise device is not important as long as it has reasonably good gain and is not a dud. This second transistor is not always needed, but in this case the light output of the LED is not that great, and the Darlington circuit makes sure that we have a large enough output current, even with weak illumination of the photo-transistor, to turn on the output LED and provide a low output voltage when light is detected.

When LED 1 is on, the Darlington transistors should both be on, and therefore LED 2 should be getting enough current to light as well. When the circuit to LED 1 is broken, then LED 2 should go off as well. LED 2 here is strictly to demonstrate to you that the coupler is coupling.

Let's look at an actual circuit; I'm going to borrow this one from the teleprinter interface of my Southwest Technical Products computer. The top of Fig. 7 shows the output from the computer to the printer. Notice how the teleprinter (which acts like a relay coil) is in series with the 4N33 coupler photo-transistor (really a Darlington) and diode D1.

When the computer outputs a 1, the inverter changes it to a 0; the resulting low voltage provides a current through the LED and lights it. This turns on the photo-transistor, and current flows from the +12 volt line down, through the printer magnet, and to −12 volts. The resis-

tance of the printer, combined with the 820 Ohm resistor, limits the current to about 20 milliamperes.

When the computer outputs a 0, the inverter changes it to a 1, and hence the LED goes off. This turns off the photo-transistor, and current in the printer stops. Hence a 1 causes a 20 mA current, while a 0 provides no current. This is what is meant by *current loop*, a term you have probably already run across.

At the bottom of Fig. 7 is the input circuit showing how the teleprinter's keyboard sends signals to the computer. In this case, the keyboard actually resembles a switch, which opens for a 0 and closes for a 1.

When the switch is closed (for a 1), about 20 mA flow through the 4N33 LED and the keyboard. This turns on the photo-transistor and grounds the input to the inverter; this ground is then inverted for a high level or 1 at the computer input.

For a 0, the switch opens, the LED and photo-transistor go off and the input to the inverter is a high level. This is then inverted into a low level or 0 at the computer input.

Note, by the way, that the keyboard and printer have similar current requirements. For both, the presence of a current through them represents a 1, while a 0 is present when there is no current.

While the teleprinter could have been connected without using optical couplers, their use is a safer step because it does help to isolate the teleprinter from the sensitive computer logic circuits. In case of teleprinter malfunction or short circuit, we may burn out the coupler, but that should be all.

Experiment #62
EIA RS-232 Interface

Problem: This current-loop interface seems archaic. Why don't they use voltages rather than currents to represent ones and zeros?

Solution: They do. Current-loop interfaces are built that way because the electromechanical nature of teleprinters happens to require current for operation. But CRT terminals, which often replace a mechanical teleprinter, do not have the same limitations and hence can use a voltage interface rather than a current interface.

Theory: Although TTL levels of 0 and about +5 volts could be used for communication between a terminal and a computer (and my own system happens to use them because I prefer them), they are really not suitable for carrying signals more than just a few meters. TTL levels are too small, and there is just not enough difference between a 1 and 0 to make sure that any noise pickup causes no problems.

Years ago, an industry committee agreed on a standard type of interface to provide this kind of connection. It is called the EIA RS-232 interface. There is still some equipment around with the older B-revision or RS-232B system, but most modern equipment uses the newer RS-232C system. (By the way, there are two new RS- specifications that have been developed in the last year, but as of now virtually nobody uses them . . . yet.) This specification applies not only to the specific voltages assigned for 0 and 1, but also covers the type of plug, which pins are used for what, what kind of source and load impedances will be used and a variety of other related functions.

As to voltages, the RS-232C interface uses a negative voltage between −3 and −15 volts for a 1 and a positive voltage between +3 and +15 volts for a 0. The region between −3 and +3 volts is a dead band which is not used and ideally should be recognized as a 1 by a device. Although it would be nice for the 1 and 0 voltages to be of different polarities but equal values, in practice this is not required except when the signal goes over very long distances. To use these "bipolar" voltages, we need circuits both to generate them as well as receive them.

Fig. 8 shows several ways to generate RS-232C levels from TTL levels. In Fig. 8a we see how a 741 operational amplifier can be used. One of its inputs is biased at about 1.4 volts, which is halfway between the maximum TTL voltage for a 0 and the minimum TTL voltage for a 1. Thus the TTL input will swing above and below 1.4 volts; as it does, the op-amp output will swing negative and positive, generating output voltages about 2 volts smaller than the positive and negative supply voltages.

In Fig. 8b we have a two-transistor circuit that does a similar job. When the TTL input is high, both transistors are on, and the output is about +4 volts. When

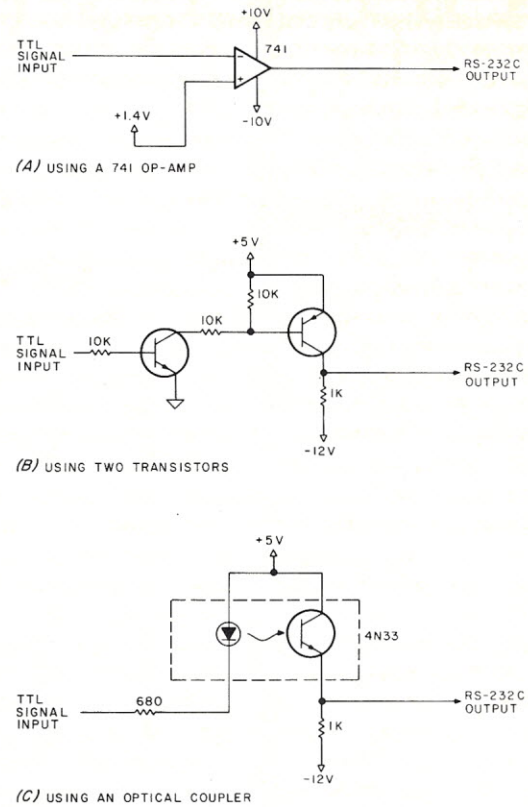


Fig. 8. Converting TTL to RS-232C levels.

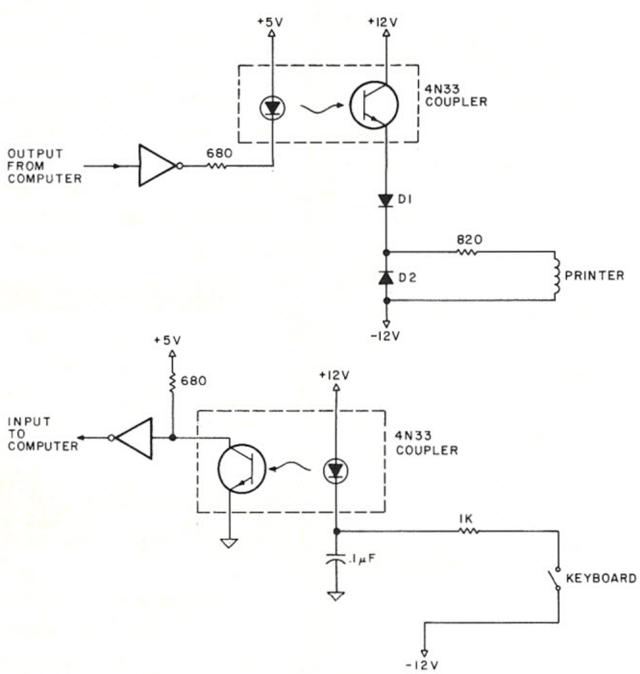


Fig. 7. Teleprinter interface used by the SWTP 6800 computer.

the TTL input is near ground, both transistors are off, and the output is near −12 volts. (This circuit needs an inverter at its input to change a 0 into a high voltage and vice versa so that the output will come out negative for a 1.)

Fig. 8c shows how an optical coupler can do the same job. When the TTL signal is a 0 or low voltage, the LED and phototransistor are both on, and the output voltage is near +5 volts. When the TTL input is 1 or high, both are off, so the output voltage is near −12 volts. No extra inverter is needed in this circuit.

Because converting from TTL to RS-232C levels is such a common job, several manufacturers make the 1488 RS-232C line driver. As shown in Fig. 9, this IC has four drivers, one of which is a plain inverter and three are NAND gates. They all invert because a positive input (1) has to produce a negative output.

Fig. 10 shows how to convert from RS-232C levels back to TTL. There are several ways to do it, but this is the simplest and most popular circuit. On a negative input, the transistor is off and the output is near +5 volts; on a positive input, the transistor is on and the output is near 0 volts. There is a 1489 IC which is also often used; as shown in Fig. 11, it has four RS-232C receivers. Each of these provides the voltage translation and inversion, and in addition has a control input (pins 2, 5, 9 and 12) that can disable the circuit or be used to shift the voltage levels to which it responds. With this long-winded introduction, let's finally get to the experiment.

Procedure: There are two circuits that are really extremely useful in many systems: RS-232C/current-loop converters. There are many cases when we want to connect a terminal having one type of connection to a computer having the other type. This can work two ways—connecting an RS-232C terminal to a current-loop interface on a computer or connecting a current-loop terminal to a computer having an RS-232C interface. The RS-232C side in both of these happens to be the same, but the current-loop side may be different.

The reason is that in an RS-232C connection the source of the data always provides a voltage, while the destination of the data always acts as a load. But in current-loop connections, the voltage source, which is in series with the circuit to provide a current of about 20 mA through it, is sometimes on the source side and sometimes on the destination side. Moreover, sometimes it is a positive source and sometimes negative. Depending on the specific combination, there are many ways of connecting to the current loop; practically every connection can use an individualized design.

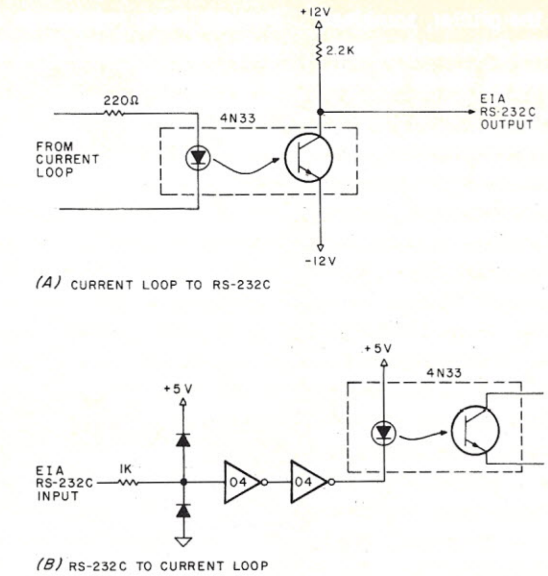


Fig. 12. RS-232C/current-loop conversion.

The most universal kind of connection, though, uses an optical coupler as shown in Fig. 12.

Start by wiring up the circuit of Fig. 12a; use the optical coupler you built before and don't forget to connect the second transistor to the phototransistor in a Darlington circuit (it's not shown in Fig. 12, but you can look up the circuit in Fig. 6). The precise positive and negative voltages don't have to be plus and minus 12; anything from about 3 to about 15 volts will work. You can use your +5 volt supply for the positive side and a 6 or 12 volt lantern battery or several dry cells for the negative side.

Connect some kind of voltmeter (sure hope you have one!) to the output. With no connection to the input, you should have a positive output. Remember that an open circuit in the current loop (that is, no current) gives a 0—the resulting positive voltage in the RS-232C circuit is what you want.

Now figure out a way to pass about 20 mA through the LED. You can do it by connecting the input to about 5 volts or by connecting to a higher voltage with an additional resistor in series. When you do this, the phototransistor should conduct and make the output go negative.

Now try the circuit of Fig. 12b. If you happen to have two optical couplers, then you can simply hook it up to the output of the first circuit; otherwise, you'll have to build it by itself.

The whole idea now is to light the LED—and turn on the phototransistor—when the input is negative, and turn them both off when the input is positive. If the RS-232C input had enough current to light the LED, we could connect the two directly together; but usually it doesn't. So we put in two 7404 inverters as amplifiers. The purpose of the 1k resistor and two diodes on the input is to limit the input voltages to the first 7404 inverter and prevent them from going above 5 volts or below 0 as the input swings positive and negative; this prevents damage to the IC.

At this point, I'll let you figure out for yourself how to check whether the photo-transistor is on or off as you connect positive and negative voltages to the input of this circuit.

Preview

This month we looked at single input and output lines and how to couple to them. Next month we will look at parallel and serial interfaces. Stay tuned! ■

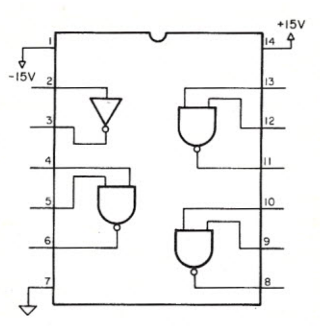


Fig. 9. Pin-out of the 1488-TTL-to-RS-232C driver.

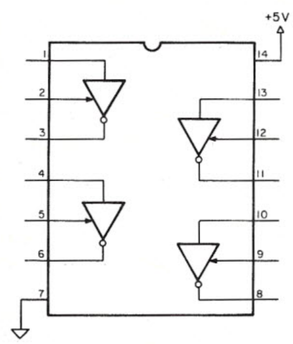


Fig. 11. Pin-out of the 1489-RS-232C-to-TTL receiver.

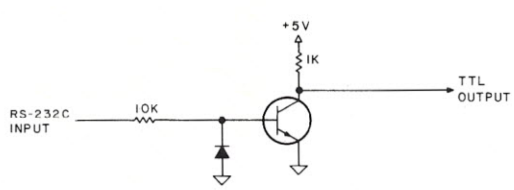


Fig. 10. Converting RS-232C levels to TTL.

Emerson Brooks
517 Melody Lane
Richardson TX 75081

Let Your Computer Wear a Watch

In this article Emerson Brooks presents another challenging and practical project for the hardware enthusiasts among us. Looks like it will be a fun project, too.

Have you ever looked at several listings of the same program and wondered which was most recently printed? If you were well disciplined, you would put a date on each listing so you could tell which was the latest . . . but few of us are that perfect. This problem can be avoided if your computer has its own watch and can read it to tell time and date and automatically put them on its printouts.

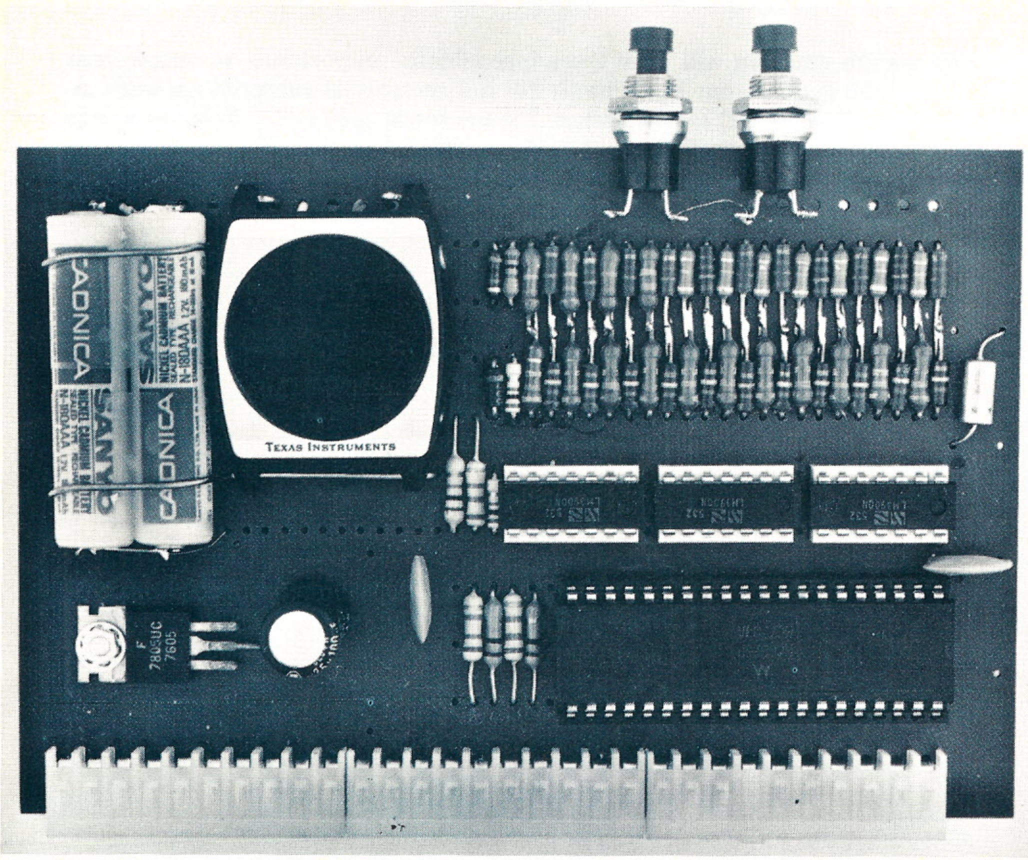


Photo 1. This circuit interfaces the digital watch to the computer through the PIA. With this circuit the computer can read time and date for printing on its output.

While there are many ways to implement a time-date function for a computer, it seemed to me that using an inexpensive digital watch was a good way to go, since it provided an integral visual readout and a means of setting, and would run off a low capacity battery to keep time when the computer was turned off. I bought a TI digital watch for $8.88 from a local drug store chain. This was relatively little to lose in case I ruined it; however, I was able to interface it with my computer with unexpected ease.

Photo 1 shows the finished circuit board with the watch mounted ready to plug into the computer. Now my listings, programs, etc., have time and date automatically printed on them.

My computer is an SWTP 6800, with a Smoke Signal dual floppy-disk system, Selectric 731 typewriter, SWTP 1024 TVT and 32K bytes of RAM. The description of the following interface is for a system similar to mine, but from my description you should be able to adapt to

your system.

The connection to the watch is made to the LED display circuit board, which is easily accessible beneath the battery. The set push-button circuit is operated by the computer to step the watch through the hour, minute, month and date sequence, while the computer reads which LED segments are on and decodes the readings to ASCII values. The following section describes the operation of the watch in more detail and tells how to make the electrical connections to it.

The watch is a CMOS device, operating on 2.5 volts. Therefore, a circuit is required to convert the watch levels to the TTL levels required by the computer. A peripheral interface adapter (PIA) serves to complete the interface between the watch and the computer. This is described in detail in the Hardware Interface section.

The watch interface is operated under computer control by means of a program described in the Software Interface section. This provides for the sequencing of operations in reading the watch, the conversion to ASCII and outputting the time and date to the typewriter. As an example, a fully commented listing for putting time and date on the listings from the SWTP Co-resident Editor-Assembler is provided.

Anatomy of a Watch

The watch I used, made by Texas Instruments, is called "TI ANYTIME Microelectronic Digital Watch" and comes in various styles of plastic cases and bands. Photo 2 shows two of the many style variations. As far as I know the internals are the same except for a variation in the battery holder and crystal configuration.

There are two buttons to operate the watch. Pushing the time button causes the watch to read time in hours and minutes, and if you hold it down it starts counting seconds. If you quickly push the time button twice, the watch reads the month and date.

The second button is recessed and is used to set the watch. Pressing the button once causes the watch to display the hour and A or P for AM or PM. To set the hour, hold down the time button, causing the hour to increment at about one-second intervals, releasing the time button when the proper hour is reached. In a similar manner, pressing the set button in sequence allows the setting of minutes, month and date. Another press of the set button turns off the set mode.

If the minutes are changed the watch stops keeping time, and when the set function is turned off, the display flashes until the time button is pressed, and the watch starts keeping time again. This allows setting the watch to the second against a time standard.

The reason I have described the set function in detail is that I decided to use the set function for reading the watch. This is the easiest way to get the AM or PM. This also makes the timing easier for reading the hours, minutes, month and date. If the time button is not pressed while in the set sequence, the watch keeps right on keeping time.

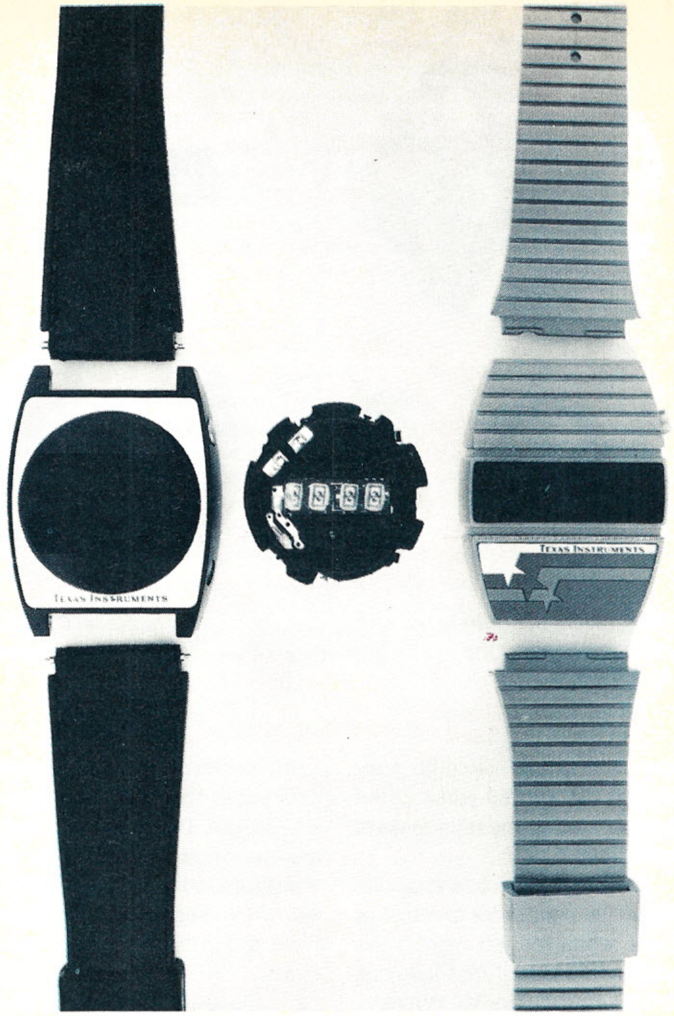


Photo 2. Here are two versions of the TI LED digital watch. In the center is the "works" from one of the watches, showing the LED display.

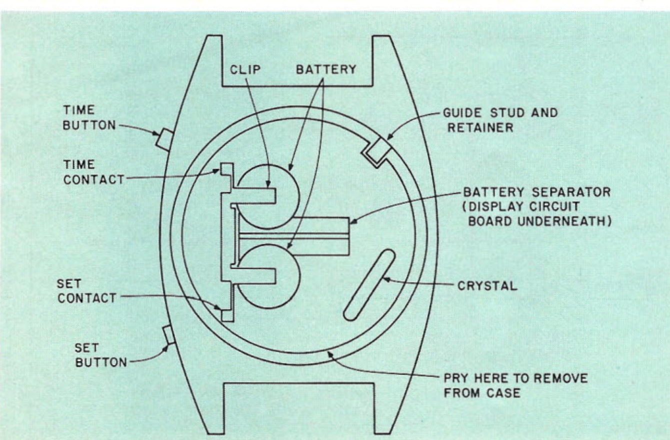


Fig. 1. This sketch of the TI watch with the back off locates the parts mentioned in the text.

The essentials of a digital watch include a crystal-controlled oscillator and a dividing circuit arranged to count seconds. Additional counting circuits count minutes, hours, days and months. All of this circuitry, except for the crystal, is in an integrated circuit buried somewhere in the watch. The IC also has circuitry for driving the LED display. Two cells supply the 2.5 volts for running the watch.

Photo 2 also shows the "works" removed from the case, viewed from the display side. If you turn the "works" over, as shown in Photo 3, you see the battery. If you remove the battery cells you will find a rubber-like separator which separates the cells. This separator is easily pulled out, and underneath it is the back of the LED display circuit board. This is where you make connections to the watch.

A variation in the watch uses a different type of battery holder, which is larger and made of hard plastic. However, it may be pried off to reveal the display circuit board. Photo 3 shows this type of battery holder as well.

Fig. 1 is a sketch of the back of the watch with the cover off. Prying gently where indicated compresses the retainer spring, and the works pop out of the case. The time and set buttons push spring contacts to initiate their functions. The spring contacts are part of the battery clip. When the switches are closed they apply 1.25 volts to

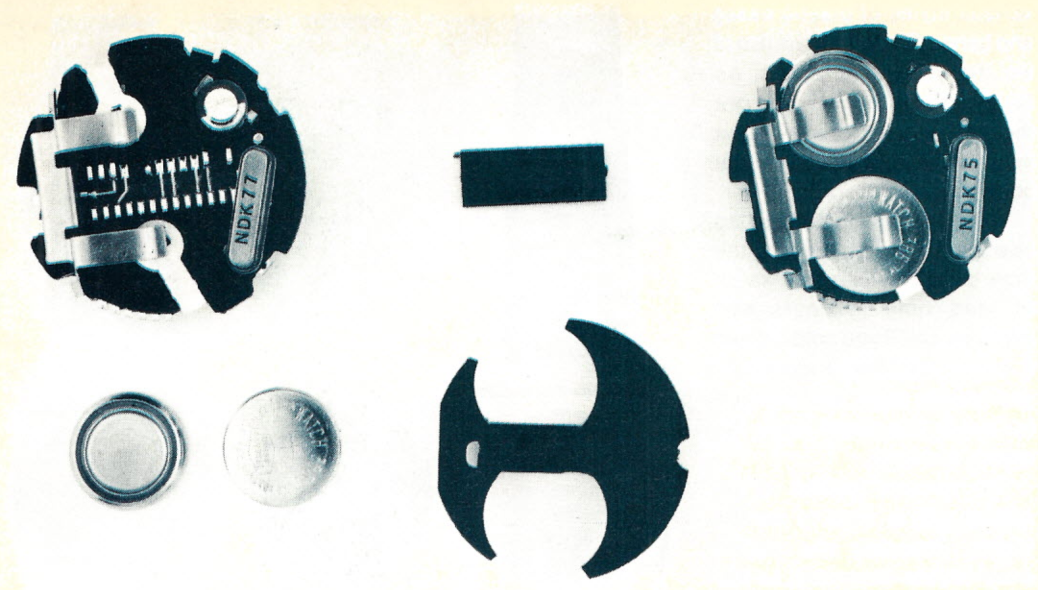


Photo 3. On the right is the watch with the battery in place. On the left the battery separator has been removed to show the back of the display PC board where connections are made to interface the watch to the computer.

the time or set circuits. I removed the clip so wires could be soldered to the time and set contacts.

The display is a 3 ½ digit display—two digits for minutes or date, while the left digit is the digit and one-half that also has the leading "1" for 10, 11 and 12 hour or month. The digits are made up of seven segments lettered A through G as shown in Fig. 2.

All segments marked A are connected together, as are all Bs, Cs, etc. These connections are the anode connections of the light emitting diodes (LED). All of the segments of a digit have a common cathode connection. To make a digit read "2," a positive voltage is applied to segment connections A, B, G, E and D, and a negative voltage is applied to the cathode.

By controlling the cathode voltage, only one digit is turned on at a time. The proper segments are made positive at the same time that the cathode is negative to make the digit display the desired character. Segment connection L provides the leading "1" for the left digit.

Fig. 2 shows the layout of the display circuit board, with the connections for the three-digit cathodes and the eight-segment anodes. The circuit board is 0.5 by 1.5 centimeters, and the connection pads are about 0.5 millimeters wide spaced on 1.0 millimeter centers.

I filed the tip of a 30 Watt soldering iron to a fine point and, using leads made of No. 30 wire-wrap wire, I soldered to the pads, using very little solder, only what the tinned lead carries on it. It is delicate work, but not difficult.

Fig. 3 shows what I have assumed to be the circuit that controls the display. Each of the segment connections has a transistor switch connecting it to the +2.5 volt supply through a current limiting resistor, while each of the digit cathodes has a transistor connecting it to the battery minus. With the transistor switches turned off, the LED is, in effect, isolated, and the voltage of its anode and cathode may be anything, depending on leakage.

To provide predictable voltages, it is necessary to supply pull-up and pull-down resistors as shown. I used 47k Ohm resistors. With these resistors installed, the waveforms are as shown in Fig. 4. The digit cathodes are about +2.5 volts when off and 0 volts when on. The segments are about 0 volts when off and about +1.7 volts when on.

The digit on-time is 1.6 milliseconds, with 0.2 ms between digit times for segment switching. When the display is on, the digits are strobed on in 1,2,3 repeating sequence, and the segments are turned on at the proper times to make the desired characters.

From the above I think you can see that to read the watch all you need, in addition to the pull-up and pull-down resistors, is a circuit that senses if the digit and segment lines are greater or less than a threshold

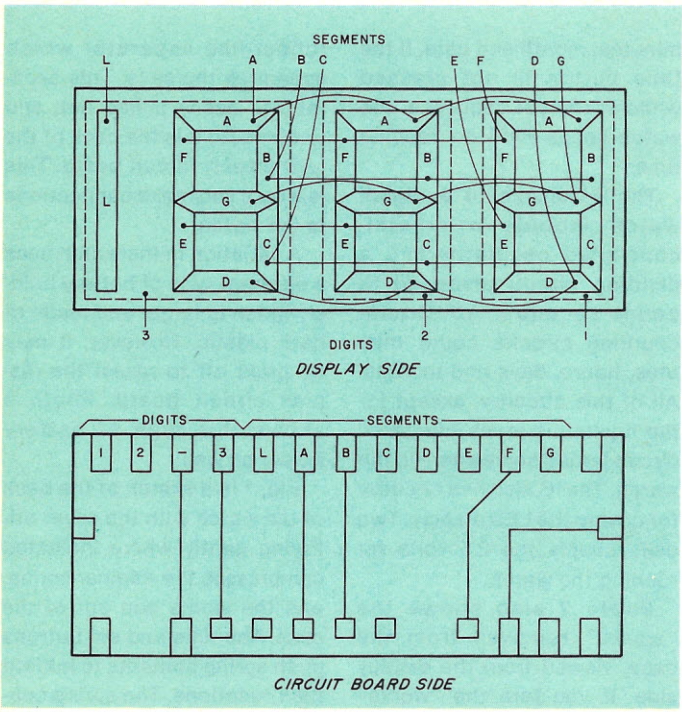


Fig. 2. The arrangement of segments in the display is shown above while the connections on the back side of the display circuit board are shown below.

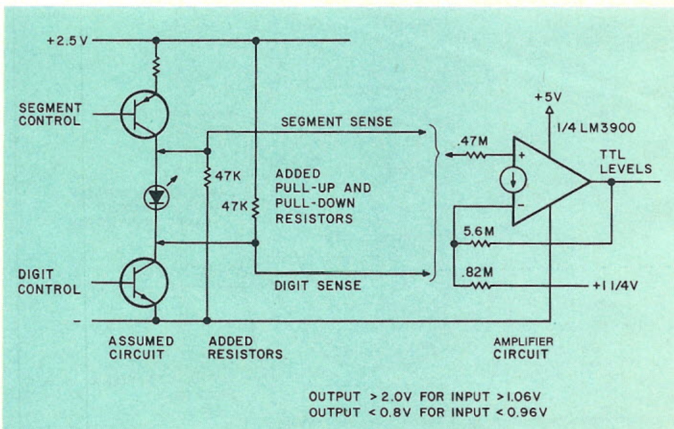


Fig. 3. A section of the display circuit shows the added pull-up and pull-down resistors. The sense amplifier changes the LED voltages to TTL levels.

set at about 1.0 volt. This is done in the hardware interface described in the next section.

Hardware Interface

The hardware interface provides two functions—a means for the computer to tell if the digit and segment lines are high or low (greater than or less than 1.0 volt), and a way for the computer to step the set function. An MC 6820 PIA provides a convenient interface to the computer data and address lines. It has 16 lines that can be programmed to be either input or output lines. Thus, one line can be programmed to be output for set, eight lines as input for the segment lines and three for digit lines, leaving four data lines and four handshaking lines unused.

The lines used as input are TTL compatible, requiring 2.0 volts or greater input for high and 0.8 volts or less for low. Therefore, circuitry is required to convert the digit and segment line voltages from the watch to the TTL levels. I did this with op amps connected in a circuit as shown in Fig. 3. I used LM3900 quad op amps, which cost less than 50 cents.

In the circuit shown, the output switches from near zero volts to near 5 volts as the current into the + input goes from slightly less than to slightly greater than the current into the − input. The resistors chosen, together with the biasing of the − input circuit to 1.25 volts, cause this switch to occur at about 1.0 volt. Other resistance values can be used as long as the above requirements are met. The values shown are what I could get for 100 for 99 cents at the local surplus store.

The complete circuit, with the exception of the control circuits for the PIA, which are the same as the SWTP MPL I/O interface board, is shown in Fig. 5. The B output section was chosen for the set control because these lines are not provided with internal pull-up resistors, which would cause the set function to be triggered whenever the PIA was reset. By using line DB-0 I can set the set control by incrementing and

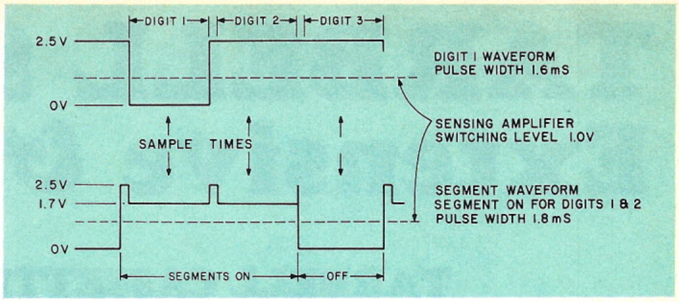


Fig. 4. Waveforms seen on the digit and segment lines. The digit is on when low (less than 1.0 volt), and the segment is on when high (more than 1.0 volt).

reset it by clearing the memory address corresponding to the B output. The voltage divider resistor circuit reduces the 5 volt supply to about 1.25 volts for the time and set controls.

The A section of the PIA is used for the eight segment lines. If you refer to Fig. 3, you will see that when a "2" is displayed, segments A, B, D, E and G are on, and the computer reads hex B6 at the memory location corresponding to the PIA data register A.

The table in Fig. 5 shows the hex value corresponding to each of the numbers from zero to 12 and the letters A and P. Of course, the computer would input the proper value only if it read the DA input at the time that the digit was on. The software described in the next section shows how the timing is accomplished by using the digit inputs connected to lines DB4, DB5 and DB6.

Power for the circuit is provided by an on-board 7805 5-volt regulator. The 12th op amp is connected as a 2.5 volt regulator for trickle charging the two nicad cells that run the watch. The diode prevents the battery from discharging through the op amp output when the computer is off.

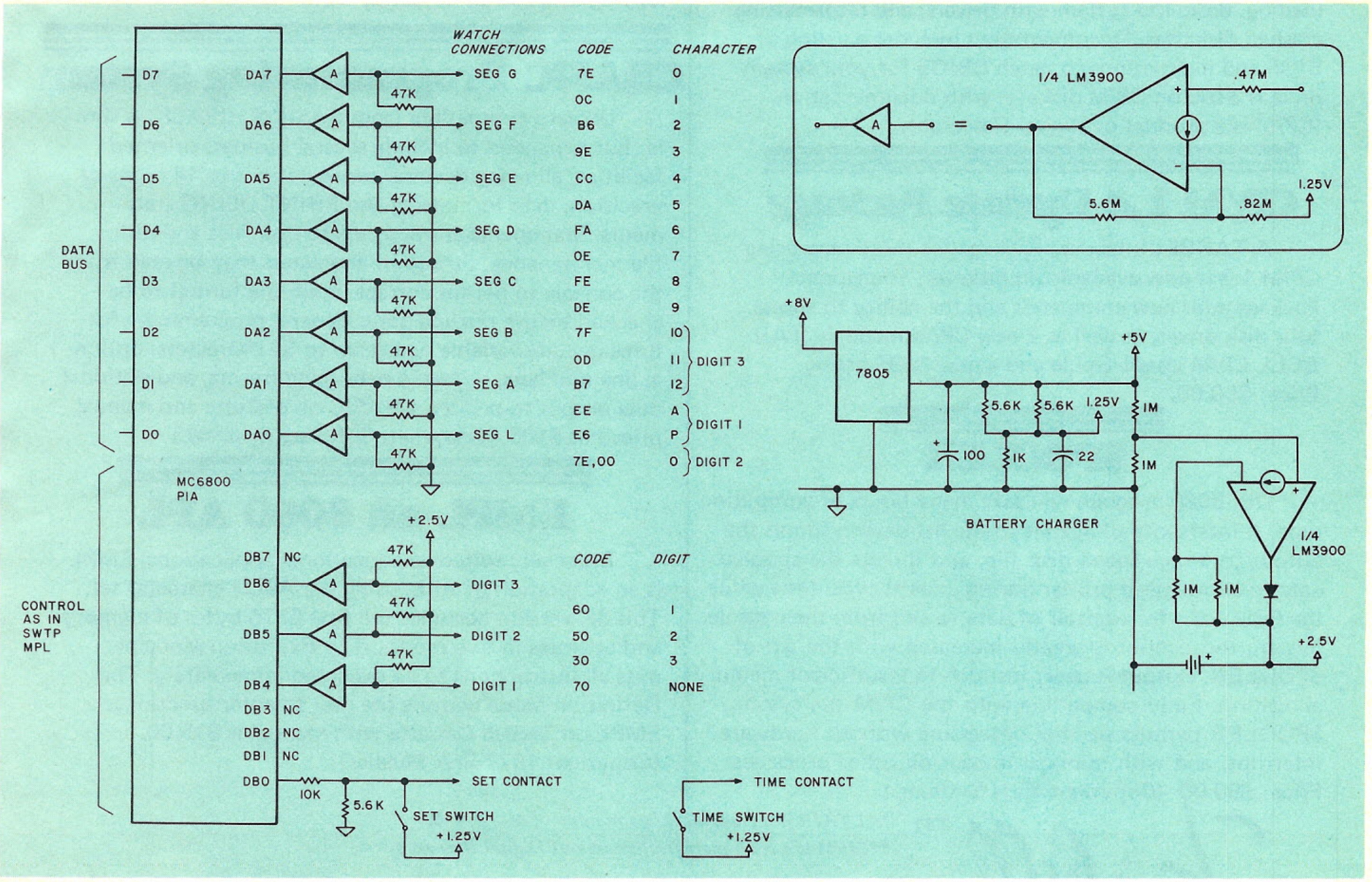


Fig. 5 The watch is interfaced to the computer through a peripheral interface adapter (PIA). While the computer is on, the battery charger charges the nicad battery that operates the watch when the computer is off.

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Designed to work with CP/M Disk Operating System this software requires a total of 20K bytes of memory. Included are 26 compiler error messages and 23 run-time error messages. Disk files may be read, written or updated by using both sequential and random access. Included are blocked and unblocked files. Price for compiler and run-time monitor on diskette is $10.00. Manual is available separately for $5.00. (Public domain software by Gordon E. Eubanks, Jr.).

CBASIC Programming System

Upward compatible from BASIC-E, CBASIC is similar but expanded to include several business oriented facilities, allowing decimal computations to 14 digits of precision, data formatting and PRINT USING statements. Statements allow access to disk files and disk file maintenance. Strings of characters may be read from the console to permit correct input line format to be checked before reading data. General programming features include variable names up to 31 characters, optional line numbers, dynamic debugging tracers, and optional data output to printer. CBASIC on diskette and manual priced at $100. (Copyright Software Systems.)

EMPL-an 8080 APL

Especially suited to educational applications, EMPL is an adaptation of APL, using the ASCII character set. This 8K version occupies the first 5376 bytes of memory and operates in two modes. The Execution Mode permits all instructions to be executed immediately. The Definition Mode permits the user to enter functions. EMPL on Tarbell Cassette with manual is $15.00. (Copyright 1977 Erik Mueller).

T11

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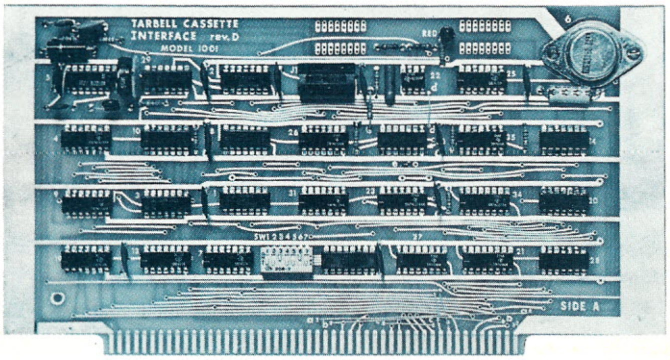

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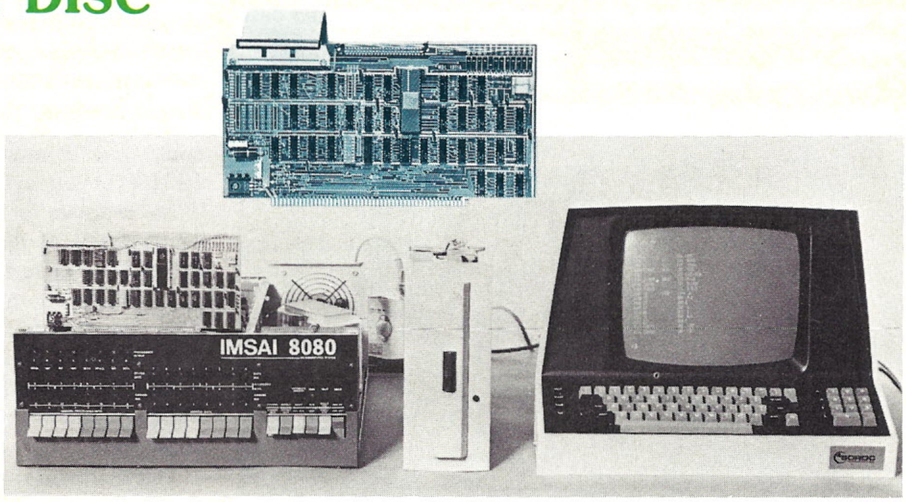

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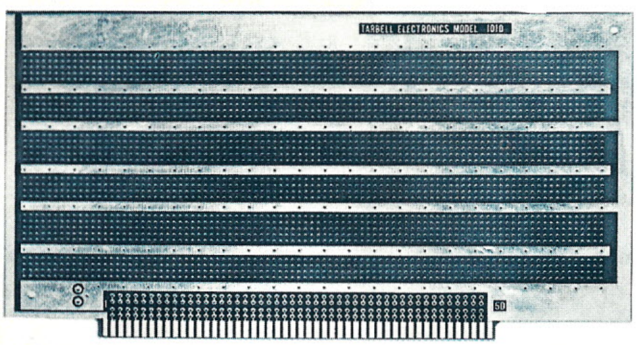

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I measured the current required by the watch to be 3 microamps when the display is not on. About 5 microamps flow through the feedback resistors in the battery charger, making a total standby load of about 8 microamps. It would take over three years to discharge the battery at this rate. A voltage divider from the 5 volt line, with a 22 uF capacitor, provides the 1.25 volt bias for the amplifier circuits.

The circuit was built on a wire-wrap breadboard that fits an I/O port in the SWTP 6800 computer. Photo 1 shows the arrangement of parts, which is not critical. The two push-button switches at the top are connected to the set and time contacts in the watch to provide a convenient way to set the watch. The view of the back of the board (Photo 4) shows the wiring.

I used Vector solder-through wire for most of the wiring. Wire-wrap wire was used for connections to the watch and connections to the connector across the bottom of the board. The board was completely wired, except for the watch. Then leads were soldered to the watch and fed through holes that were labeled to show the connection. The watch was then fastened to the board, and the leads to the watch trimmed to length and soldered to the proper place in the circuit. When you connect the battery to the watch, it should run, and you should be able to set it and read it using the push buttons at the top of the board.

Software Interface

Software is required to read the watch and print the time and date. The complete software for putting time and date on the SWTP Co-resident Editor-Assembler is shown in the Program listing. A little study of the listing should enable you to write the software for your computer. The program is assembled starting at address hex 7084, which is compatible with my operating system. You could put it anywhere convenient for your system.

The program for reading the watch starts at READ on line 930 and includes the steps of getting in synchronism with the digit pulse, reading the segment pattern and decoding the pattern to an ASCII character. Fig. 6 is a flowchart of the READ subroutine.

The decoding is done by means of a lookup table. Values in the table are in pairs, the first byte being the segment pattern, and the following byte the corresponding ASCII code. The table starts at line 1750. The codes for "10," "11" and "12" are indicated by setting the most significant bit of the ASCII code for "0," "1" and "2."

For days of the month from 1 to 9 the watch suppresses the 10's place digit. This gives a segment pattern of hex 00, which the table interprets as ASCII "0." This null byte is also sampled on line 1070 to tell when the end of the table has been reached with no match . . . a failure condition . . . and exits the subroutine.

The GETIME subroutine, starting at line 520, causes the watch to be read and sets up the time and date in a string to the pattern shown at the top of the listing page. The location for the character in the string is indicated by the address in POINT. After setting up the PIA, the subroutine branches to CLRSW, which makes sure the set function of the watch is in the off condition.

After making sure the set function is off, the program branches to SESQUI, which reads the hour. SESQUI sets accumulator A for digit #3 and branches to RDNXT, which steps the set switch to set hour and reads digit #3 on the watch. On returning, the ASCII code is tested to see if the value is 10, 11 or 12, in which case "1" is put in the string. Otherwise, a space is entered. Then the least significant hour digit is put in the string.

Next the character "A" or "P" is read from digit #1 and stored on the stack until later. A colon is put in the string to separate hours and minutes, and the program branches to DOUBLE. DOUBLE steps the step switch once and reads digits #2 and #1 and stores them in the string.

Then the "A" or "P" is pulled from the stack and put in the string followed by an "M" and space. In a similar manner the month and day are read from the watch and put in the string separated by a slash. Finally, the year "78" is put in the

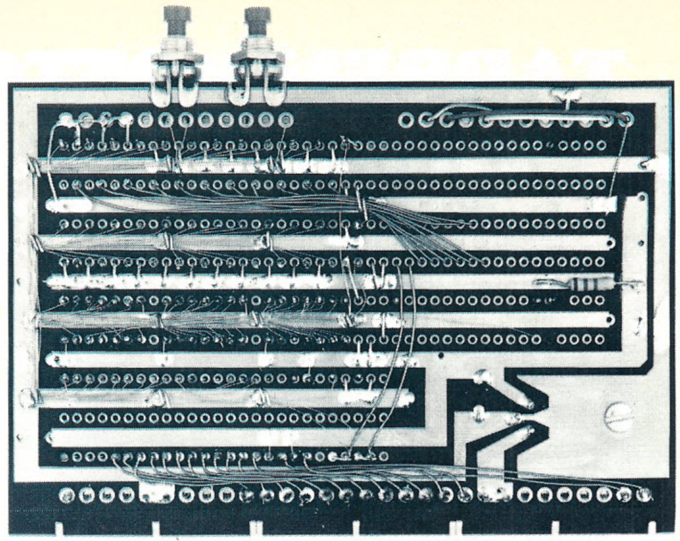


Photo 4. This photo shows how the wiring of the circuit board was done using Vector solder-through wire. The push buttons at the top are for setting the watch.

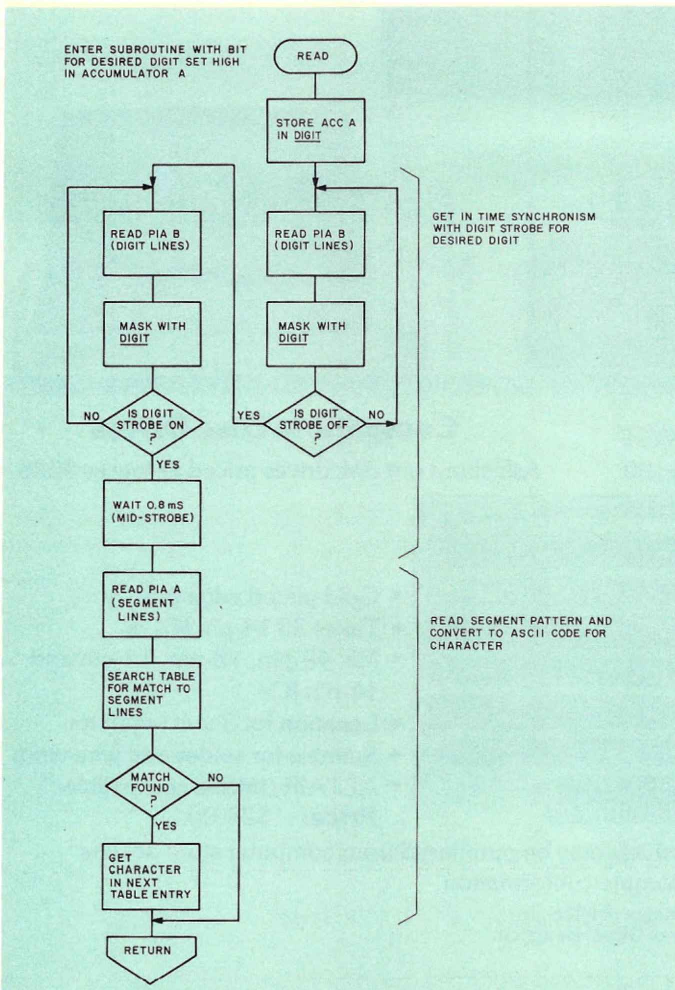


Fig. 6. The READ subroutine synchronizes the computer to the watch's display strobing and reads a character as shown in this flowchart.

string, and the set function stepped to off.

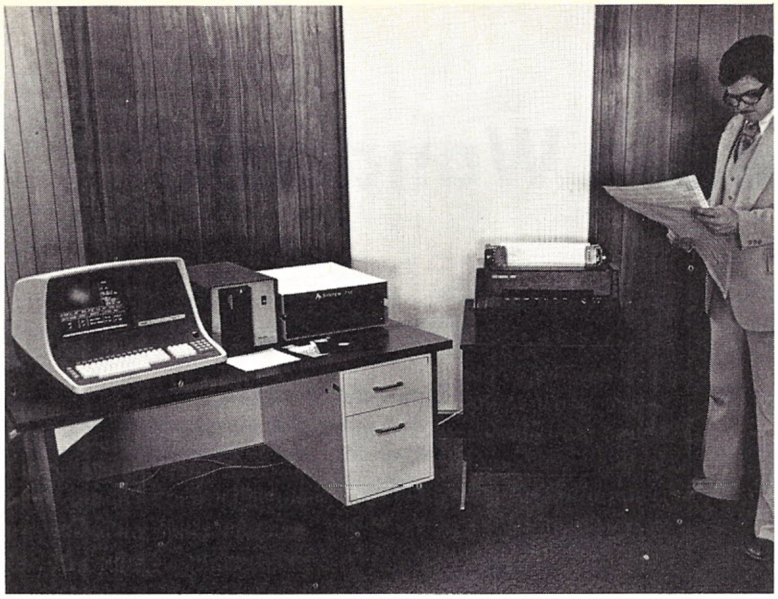
The watch reading program must be properly interfaced to the program with which it is going to run, the Co-resident Editor-Assembler in this case. When running the Editor-Assembler, if you type in "AS" to go to assembler, the program instead jumps to GETIME to fill the string with time and date, and then jumps to the assembler program. Then when a listing is being printed and the page heading is being typed, the time-date string is printed following the name.

The listing also shows the changes you need to make in Co-resident Editor-Assembler so that it can work with the time-date program. After you understand the sequence of operation, you can interface the date-time program with any program you wish. So far I have interfaced it with the TSC Editor, TSC Disassembler, the Smoke Signal Assembler and SWTP 8K BASIC.■

Program listing.

```
PAGE  001    CORESTIME           9:03PM  5/11/78

                         NAM    CORESTIME

                         OPT    O

                   *PROGRAM TO GET AND PRINT TIME AND DATE
                   *ON PAGE HEADER OF SWTPC CORESIDENT
                   *EDITOR ASSEMBLER LISTING OUTPUT.
                   *FORMAT: 12:34AM 11/22/78
                   *INTERFACE FORMAT THROUGH PIA
                   *  PIADA--SEGMENTS GFEDCBAL  L=LEADING 1
                   *  PIADB--DIGITS   X321XXXS  S=STEP CONTROL
                   *STEP SWITCH SEQUENCE (DIGIT)
                   *  1-HOUR (1), A OR P (3)
                   *  2-MINUTES (2,3)
                   *  3-MONTH (1)
                   *  4-DAY (2,3)
                   *  5-OFF
                   *PROGRAM RUNS IN DOS TRANSIENT AREA, STARTING
                   *AT LOCATION $7084.

7084                     ORG    $7084

                   *JSR HERE FROM CORES-EDASM AT START OF NEW PAGE.
                   *PUT $7084 IN CORES-EDASM AT $06E3 FOR JSR.
                   *PUT $04 AT $0596 TO STOP PRINTING AFTER NAME
                   *TO PROVIDE SPACE FOR TIME-DATE.

      7084  PRTMDT EQU    *         PRINT PAGE HEADER
7084 BD 0133        JSR    PCRSTR    PRINT PAGE NUMBER, NAME
7087 CE 7183        LDX    #TIME     PRINT TIME-DATE STRING
708A BD 0136        JSR    PSTRNG    PRINT STRING TO $04
708D CE 0597        LDX    #LFSTNG   PRINT LINE FEEDS
7090 7E 0136        JMP    PSTRNG    AND RTS

7093 86 2F   SLASH  LDA A  #'/       PUT SLASH IN STRING
7095 20 02          BRA    PUT

7097 86 20   PUTS   LDA A  #$20      PUT SPACE IN STRING

7099 FE 7180 PUT    LDX    POINT     PUT CHARACTER IN STRING AT
709C A7 00          STA A  0,X       ADDR POINTED TO BY POINT
709E 08             INX              INCREMENT INDEX AND
709F FF 7180        STX    POINT     SAVE IN POINT
70A2 CE 801C        LDX    #PIA      RESTORE INDEX
70A5 39             RTS

                   *JMP HERE FROM CORES-EDASM BEFORE STARTING ASSEMBLY.
                   *PUT $70A6 IN CORES-EDASM AT $15FA FOR JMP.
                   *WHEN TIME-DATE STRING IS FILLED JMP TO ASSEMBLE
                   *IN CORES-EDASM AT $1A53.

      70A6  GETIME EQU    *         PUT TIME, DATE IN STRING
70A6 CE 7183        LDX    #TIME     STARTING ADDR FOR POINT
70A9 FF 7180        STX    POINT
70AC CE 801C        LDX    #PIA      SET UP PIA TO READ WATCH
70AF 6F 00          CLR    0,X       CLEAR REGISTERS
70B1 6F 01          CLR    1,X
70B3 6F 02          CLR    2,X
70B5 6F 03          CLR    3,X
70B7 86 01          LDA A  #$01      SET BIT 0 PIADB FOR OUTPUT
70B9 A7 02          STA A  2,X
70BB 86 04          LDA A  #$04      SET PIA CONTROL REGISTERS
70BD A7 01          STA A  1,X
70BF A7 03          STA A  3,X
70C1 8D 76          BSR    CLRSW     CLEAR SWITCH SEQUENCE
70C3 8D 54          BSR    SESQUI    GET AND PUT HOUR
70C5 86 10          LDA A  #%00010000  GET A OR P, DIGIT #1
70C7 8D 29          BSR    READ      GO READ
70C9 36             PSH A            AND SAVE IT
70CA 86 3A          LDA A  #':       PUT COLON
70CC 8D CB          BSR    PUT
70CE 8D 5D          BSR    DOUBLE    GET AND PUT MINUTES
70D0 32             PUL A            PUT A OR P
70D1 8D C6          BSR    PUT
70D3 86 4D          LDA A  #'M       PUT M
70D5 8D C2          BSR    PUT
70D7 8D BE          BSR    PUTS      PUT SPACE
70D9 8D 3E          BSR    SESQUI    GET AND PUT MONTH
70DB 8D B6          BSR    SLASH     PUT SLASH
70DD 8D 4E          BSR    DOUBLE    GET AND PUT DAY
70DF 8D B2          BSR    SLASH     PUT SLASH
70E1 86 37          LDA A  #'7       PUT YEAR
70E3 8D B4          BSR    PUT
70E5 86 38          LDA A  #'8
70E7 8D B0          BSR    PUT
70E9 8D 4E          BSR    CLRSW     CLEAR SWITCH
70EB 7E 1A53        JMP    ASSEM     JMP TO ASSEMBLE

70EE 20 A9   PUT1   BRA    PUT

      70F0  RDNXT  EQU    *         STEP SWITCH, READ CHARACTER
70F0 8D 59          BSR    STEPS     STEP SWITCH
      70F2  READ   EQU    *         READ CHARACTER
70F2 B7 7182        STA A  DIGIT     SAVE DIGIT #
70F5 A6 02   DIGOFF LDA A  2,X       GET IN SYNC WITH STROBE
70F7 B4 7182        AND A  DIGIT
70FA 27 F9          BEQ    DIGOFF    WAIT UNTIL DIGIT IS OFF (=1)
70FC A6 02   DIGON  LDA A  2,X       NOW WAIT UNTIL DIGIT IS ON
70FE B4 7182        AND A  DIGIT
7101 26 F9          BNE    DIGON
7103 C6 01          LDA B  #1        WAIT FOR MID-STROBE
7105 8D 4E          BSR    TIMER
7107 A6 00          LDA A  0,X       GET CHARACTER
7109 CE 715C        LDX    #TABLE-4  CONVERT TO ASCII
710C 08      SEARCH INX
710D 08             INX
710E 6D 00          TST    0,X
7110 27 06          BEQ    RETN      END OF LIST, NO MATCH, EXIT
7112 A1 02          CMP A  2,X       TEST CHARACTER
7114 26 F6          BNE    SEARCH    IF NO MATCH, GET NEXT CHAR
```

```
7116 A6 03           LDA A  3,X        MATCH--NOW GET ASCII
7118 39      RETN    RTS

     7119    SESQUI  EQU    *          GET HOUR OR MONTH
7119 86 40           LDA A  #%01000000  SET FOR DIGIT #3
711B 8D D3           BSR    RDNXT      GO STEP AND READ
711D 16              TAB               TEST FOR LEADING 1
711E 4F              CLR A             (BIT 7 SET)
711F 5D              TST B
7120 2A 02           BPL    NOT1
7122 86 11           LDA A  #$11       =(ASCII 1) - (ASCII SPACE)
7124 8B 20   NOT1    ADD A  #$20       OTHERWISE SPACE
7126 8D C6           BSR    PUT1
7128 17              TBA               GET SECOND DIGIT
7129 84 7F           AND A  #$7F       CLEAR LEADING 1 FLAG
712B 20 C1           BRA    PUT1

     712D    DOUBLE  EQU    *          GET MINUTES OR DAY
712D 86 20           LDA A  #%00100000  SET FOR DIGIT #2
712F 8D BF           BSR    RDNXT      GO STEP AND READ
7131 8D BB           BSR    PUT1
7133 86 10           LDA A  #%00010000  SET FOR DIGIT #1
7135 8D BB           BSR    READ       GO READ
7137 20 B5           BRA    PUT1

     7139    CLRSW   EQU    *          CLEAR SAMPLE SWITCH
7139 86 08           LDA A  #$8        TEST 8 TIMES
713B 6D 00   TEST    TST    0,X
713D 27 04           BEQ    NXTST
713F 8D 0A           BSR    STEPS      NOT CLEAR, GO STEP
7141 20 F6           BRA    CLRSW      TEST AGAIN
7143 C6 01   NXTST   LDA B  #1         MOVE OVER HALF STROBE
7145 8D 0E           BSR    TIMER
7147 4A              DEC A
7148 26 F1           BNE    TEST       AND TEST AGAIN
714A 39              RTS

     714B    STEPS   EQU    *          STEP SAMPLE SWITCH
714B 6C 02           INC    2,X        SET STEP CONTROL BIT
714D C6 7D           LDA B  #125       WAIT 100 MS
714F 8D 04           BSR    TIMER
7151 6F 02           CLR    2,X        RESET STEP CONTROL BIT
7153 C6 AF           LDA B  #175       WAIT 140 MS

     7155    TIMER   EQU    *          TIME = 0.8MS * ACC B
7155 37              PSH B
7156 C6 74           LDA B  #116
7158 5A      WAIT    DEC B
7159 26 FD           BNE    WAIT
715B 33              PUL B
715C 5A              DEC B
715D 26 F6           BNE    TIMER
715F 39              RTS

             *TABLE FOR CONVERSION OF SEGMENT CODE TO ASCII.
             *BYTE VALUES ARE IN PAIRS:
             *   1ST BYTE IS SEGMENT CODE FROM PIADA.
             *   2ND BYTE IS CORRESPONDING ASCII CHARACTER.
             *IF DIGIT 2 IS BLANK (PIADA=$00), CHAR=ASCII 0.
             *IF DIGIT 3 SEGMENT CODE LSB=1, THEN NUMBER IS
             *10, 11, OR 12. SET BIT 7 OF ASCII 0, 1, OR 2
             *AS LEADING 1 FLAG.

     7160    TABLE   EQU    *
7160 7E              FCB    $7E,'0
7161 30
7162 0C              FCB    $0C,'1
7163 31
7164 B6              FCB    $B6,'2
7165 32
7166 9E              FCB    $9E,'3
7167 33
7168 CC              FCB    $CC,'4
7169 34
716A DA              FCB    $DA,'5
716B 35
716C FA              FCB    $FA,'6
716D 36
716E 0E              FCB    $0E,'7
716F 37
7170 FE              FCB    $FE,'8
7171 38
7172 DE              FCB    $DE,'9
7173 39
7174 7F              FCB    $7F,'0+$80
7175 B0
7176 0D              FCB    $0D,'1+$80
7177 B1
7178 B7              FCB    $B7,'2+$80
7179 B2
717A EE              FCB    $EE,'A
717B 41
717C E6              FCB    $E6,'P
717D 50
717E 00              FCB    $00,'0
717F 30

     7180    POINT   EQU    *
7180 7183            FDB    *+3
     7182    DIGIT   EQU    *
7182 00              FCB    $00

     7183    TIME    EQU    *          TIME STRING
7183 20              FCB    $20,'0,':,'0,'0,'A,'M,$20
7184 30
7185 3A
7186 30
7187 30
7188 41
7189 4D
718A 20
     718B    DATE    EQU    *          DATE STRING
718B 20              FCB    $20,'0,'/,'0,'0,'/,'7,'8,$0D,$04
718C 30
718D 2F
718E 30
718F 30
7190 2F
7191 37
7192 38
7193 0D
7194 04

     801C    PIA     EQU    $801C      WATCH PORT ADDRESS

             *CORES-EDASM ADDRESSES
     0133    PCRSTR  EQU    $0133      PRINT CR,LF'S,PAGE#,NAME
     0136    PSTRNG  EQU    $0136      PRINT STRING TO $04
     0597    LFSTNG  EQU    $0597      LINE FEED STRING
     1A53    ASSEM   EQU    $1A53      CORES-EDASM ASSEMBLE ADDR

                     END
```



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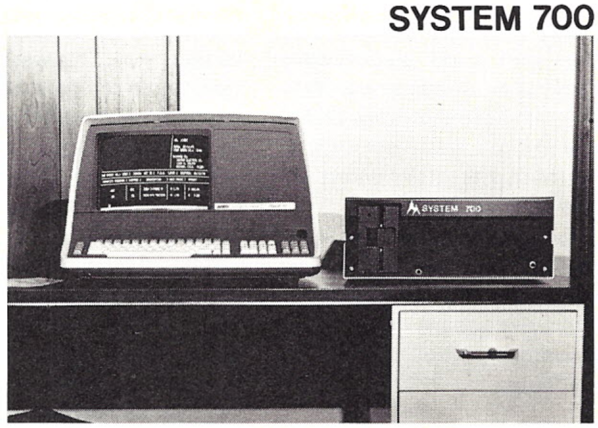

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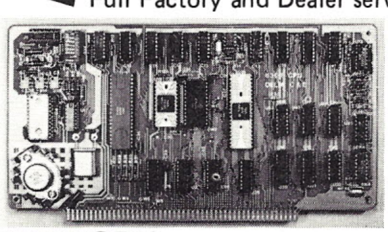

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Randomness is Wonderful

How random is your BASIC's random number generator? Here's a simple way to find out.

Have you ever wondered what kind of numbers your random-number generator was throwing out? What kind of sequence, if any, it might generate? What about repeatability (generally not desirable)?

Curiosity about these questions prompted me to develop the accompanying program to determine if the random-number generator in my BASIC interpreter actually was developing genuinely random numbers with a low predictability factor. As numerous runs of the program have shown, my BASIC is making a pretty good distribution that is totally unpredictable over the long term.

Random numbers are used mostly in games to create a set of conditions to represent the computer's move in which the operator is pitted against the computer.

The Program

The program is essentially self-explanatory, but I would like to call your attention to a few key features. The first input request determines the size of the sample to be processed and can be as small as two digits. Any number below 50 doesn't give very meaningful results, however. A number larger than five digits requires a considerable amount of processing time.

By your response to line 60, you have the option of having either all of the numbers printed in the sequence in which they are generated, or only a summary of the results printed. Generally, for a large sampling of numbers (say over 500), it would be impractical and cumbersome to have each number printed out because of the amount of time and paper it would require. This is the test for repeatability, however.

This program was developed for use on a Teletype with five print zones, so the statement at line 130 works quite simply and adequately for output. If you are using some other output device, you may have to modify or add to this statement to make the output compatible with your equipment.

At line 110 you will note that I multiplied the random number results by 10. This was done so that I could compare the results on a more convenient scale of 1 to 10, rather than use decimals. It does not alter the proportional relationships of the numbers, though.

Professional programmers with extended versions of BASIC could shorten this program up quite a bit, but I purposely did it this way so that anyone could run it on any version of BASIC. The summary printout of the program starts at line 720 and gives the actual distribution of numbers by categories from 1 to 10 and the percentage ratios of each. You will quickly note that for a very small-sized sampling of numbers, the distribution may be quite uneven, but very large samplings should be quite evenly distributed, if your program and computer are working properly.

The principal usage of the program is to determine if your random-number generator program is working properly, but it also has a limited use as a benchmark timing program. For instance, on my machine with a sample size of 10,000 and no numbers printed, it takes 119 seconds to run from the carriage return at line 65 to line 700, where a line feed occurs.

A portion of this program can also be incorporated into a program that I am working on for the study of probability factors.

A Final Thought

I have found that for best results with random numbers, the RANDOMIZE statement should always be placed in the program loops, rather than just at the beginning of the program, so that it precedes each RND (X) generation statement (see line 580 in this example). It does not hurt anything to include the RANDOMIZE statement several times in a program, if necessary, where the random number generation loops are nested. ■

```
RUN
SIZE OF SAMPLE DESIRED ?100
DO YOU WANT NUMBERS PRINTED (1=YES, Ø=NO) ?1

NUMBERS PRINTED IN SEQUENCE AS GENERATED.

 3.36691      4.16172      4.66807      .552973      1.30522
 2.85457      5.38041      6.59136      1.12448      7.42465
 4.42759      9.74364      8.61356      3.98856      6.40935
 2.55905      7.67014      2.98935      8.90487      6.52511
 9.00678      5.31471      .82725       7.1311       5.34137
 7.86828      9.13737      4.0097       1.82189      4.84403
 2.66715      2.40667      .435633      .953811      1.80217
 2.22871      7.15273      2.85804      2.77363      .919461
 .554098      5.04944      5.30976      6.4136       .693731
 6.44002      2.39653      6.41903      6.94539      3.90105
 .89779       .277294      3.58365      9.00627      1.78473
 9.65199      1.84935      4.22815      8.72479      4.29542
 7.24935      4.83733      3.77987      9.14327      .840763
 2.75514      8.96396      8.98752      3.24949      8.60926
 2.41012      6.97737      .173153      8.24254      7.89687
 3.19837      8.11837      9.92488      6.48392      9.57963
 9.12248      8.51827      9.00727      7.37917      3.20958
 2.845        8.18373      3.49742      7.33094      2.50887
 9.07478      1.8688       9.53982      .419699      6.65979
 6.18147      7.15066      7.27077      9.26868      .175127


TOTAL OF RANDOM NUMBERS SAMPLED  100

NUMBERS FROM Ø TO 1 :   13          PERCENTAGE OF TOTAL :   13  %
NUMBERS FROM 1 TO 2 :   7           PERCENTAGE OF TOTAL :   7  %
NUMBERS FROM 2 TO 3 :   13          PERCENTAGE OF TOTAL :   13  %
NUMBERS FROM 3 TO 4 :   9           PERCENTAGE OF TOTAL :   9  %
NUMBERS FROM 4 TO 5 :   8           PERCENTAGE OF TOTAL :   8  %
NUMBERS FROM 5 TO 6 :   5           PERCENTAGE OF TOTAL :   5  %
NUMBERS FROM 6 TO 7 :   11          PERCENTAGE OF TOTAL :   11  %
NUMBERS FROM 7 TO 8 :   11          PERCENTAGE OF TOTAL :   11  %
NUMBERS FROM 8 TO 9 :   10          PERCENTAGE OF TOTAL :   10  %
NUMBERS FROM 9 TO 10 :  13          PERCENTAGE OF TOTAL :   13  %

READY
RUN
SIZE OF SAMPLE DESIRED ?12000
DO YOU WANT NUMBERS PRINTED (1=YES, Ø=NO) ?Ø


TOTAL OF RANDOM NUMBERS SAMPLED  12000

NUMBERS FROM Ø TO 1 :   1218        PERCENTAGE OF TOTAL :   10.15  %
NUMBERS FROM 1 TO 2 :   1193        PERCENTAGE OF TOTAL :   9.94167  %
NUMBERS FROM 2 TO 3 :   1172        PERCENTAGE OF TOTAL :   9.76667  %
NUMBERS FROM 3 TO 4 :   1177        PERCENTAGE OF TOTAL :   9.80833  %
NUMBERS FROM 4 TO 5 :   1240        PERCENTAGE OF TOTAL :   10.3333  %
NUMBERS FROM 5 TO 6 :   1200        PERCENTAGE OF TOTAL :   10  %
NUMBERS FROM 6 TO 7 :   1170        PERCENTAGE OF TOTAL :   9.75  %
NUMBERS FROM 7 TO 8 :   1211        PERCENTAGE OF TOTAL :   10.0917  %
NUMBERS FROM 8 TO 9 :   1229        PERCENTAGE OF TOTAL :   10.2417  %
NUMBERS FROM 9 TO 10 :  1190        PERCENTAGE OF TOTAL :   9.91667  %
```

Sample run.

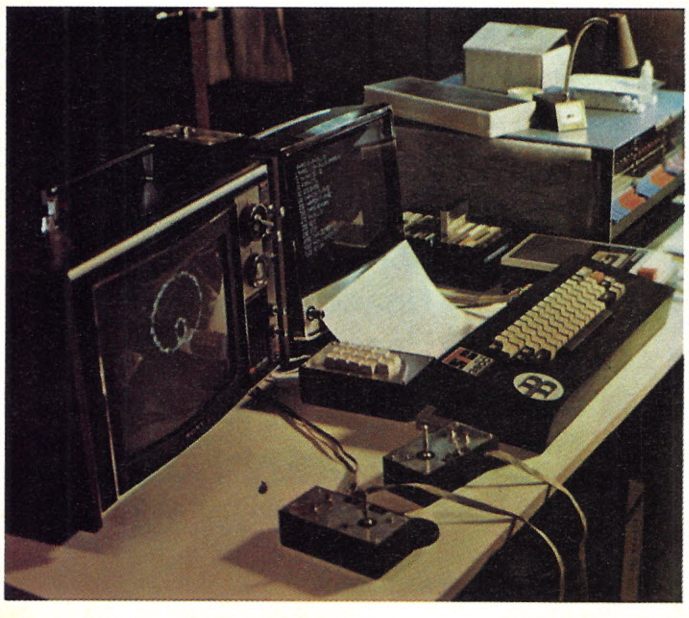
```
10 REM        PROGRAM TO DETERMINE THE DISTRIBUTION
20 REM        OF RANDOM NUMBERS ON A 1 TO 10 BASIS.
25 REM                PROGRAM  RN - 2
30 REM
40 REM
50 PRINT "SIZE OF SAMPLE DESIRED ";
55 INPUT K
60 PRINT "DO YOU WANT NUMBERS PRINTED (1=YES, 0=NO) ";
65 INPUT L
70 IF L<1 GO TO 100
75 PRINT
80 PRINT "NUMBERS PRINTED IN SEQUENCE AS GENERATED."
90 PRINT
100 RANDOMIZE
110 LET X=RND(0)*10
120 IF L<1 GO TO 140
130 PRINT X,
140 IF X<1 GO TO 250
150 IF X<2 GO TO 280
160 IF X<3 GO TO 310
170 IF X<4 GO TO 340
180 IF X<5 GO TO 370
190 IF X<6 GO TO 400
200 IF X<7 GO TO 430
210 IF X<8 GO TO 460
220 IF X<9 GO TO 490
230 IF X<10 GO TO 520
240 IF X=10 GO TO 520
250 LET A=A+1
270 GO TO 550
280 LET B=B+1
300 GO TO 550
310 LET C=C+1
330 GO TO 550
340 LET D=D+1
360 GO TO 550
370 LET E=E+1
390 GO TO 550
400 LET F=F+1
420 GO TO 550
430 LET G=G+1
450 GO TO 550
460 LET H=H+1
480 GO TO 550
490 LET I=I+1
510 GO TO 550
520 LET J=J+1
540 GO TO 550
550 LET K1=A+B+C+D+E
560 LET K2=F+G+H+I+J
570 IF K1+K2=K GO TO 600
580 GO TO 100
590 REM
600 LET M=(A/K)*100
610 LET N=(B/K)*100
620 LET O=(C/K)*100
630 LET P=(D/K)*100
640 LET Q=(E/K)*100
650 LET R=(F/K)*100
660 LET S=(G/K)*100
670 LET T=(H/K)*100
680 LET U=(I/K)*100
690 LET V=(J/K)*100
700 PRINT
710 PRINT
720 PRINT "TOTAL OF RANDOM NUMBERS SAMPLED ";K
730 PRINT
740 PRINT "NUMBERS FROM 0 TO 1 :  ";A;
750 PRINT TAB(35);"PERCENTAGE OF TOTAL :  ";M;" %"
760 PRINT "NUMBERS FROM 1 TO 2 :  ";B;
770 PRINT TAB(35);"PERCENTAGE OF TOTAL :  ";N;" %"
780 PRINT "NUMBERS FROM 2 TO 3 :  ";C;
790 PRINT TAB(35);"PERCENTAGE OF TOTAL :  ";O;" %"
800 PRINT "NUMBERS FROM 3 TO 4 :  ";D;
810 PRINT TAB(35);"PERCENTAGE OF TOTAL :  ";P;" %"
820 PRINT "NUMBERS FROM 4 TO 5 :  ";E;
830 PRINT TAB(35);"PERCENTAGE OF TOTAL :  ";Q;" %"
840 PRINT "NUMBERS FROM 5 TO 6 :  ";F;
850 PRINT TAB(35);"PERCENTAGE OF TOTAL :  ";R;" %"
860 PRINT "NUMBERS FROM 6 TO 7 :  ";G;
870 PRINT TAB(35);"PERCENTAGE OF TOTAL :  ";S;" %"
880 PRINT "NUMBERS FROM 7 TO 8 :  ";H;
890 PRINT TAB(35);"PERCENTAGE OF TOTAL :  ";T;" %"
900 PRINT "NUMBERS FROM 8 TO 9 :  ";I;
910 PRINT TAB(35);"PERCENTAGE OF TOTAL :  ";U;" %"
920 PRINT "NUMBERS FROM 9 TO 10 : ";J;
930 PRINT TAB(35);"PERCENTAGE OF TOTAL :  ";V;" %"
950 END
```

Program listing.

Jon A. Rick
531 Community Dr.
Battle Creek MI 49017

Dazzler and BASIC

Cromemco's TV Dazzler can be used to produce some incredible graphics, but using it with BASIC has been a problem. No longer!



Author's system.

In a previous article in *Kilobaud*, I presented a series of subroutines that simplified the 8080 assembly-language programmer's task of drawing on Cromemco's TV Dazzler ("Draw Dazzling Color Graphics . . . routines for Cromemco's Dazzler," *Kilobaud* No. 19). If stored in PROM, as they are in my Imsai 8080, these routines are easy to use not only in assembly language, but also in BASIC.

The purpose of this article is to discuss the implementation of the Dazzler routines in BASIC. I have chosen two readily available interpreters—Imsai 8K Version 1.4 and Processor Technology 5K. The Imsai BASIC, like many 8K or larger BASICs, allows the POKE and CALL verbs. The technique will also probably apply to your BASIC.

Processor Technology 5K does not have the POKE command, and its implementation is more complicated. However, I feel the discussion is worthwhile because that BASIC is good, available and, best of all, cheap.

Imsai BASIC Mods

Imsai BASIC assumes that all the memory above 8K up to the first read-only or nonexistent memory is available for its exclusive use. Therefore, any user-written modifications above 8K are likely to be destroyed by BASIC.

There are two solutions to this problem. First, install some random-access memory (RAM) at a higher address; second, if you cannot afford the extra RAM, find some unused locations in the first 8K.

Since most of my Dazzler software is located in the BYTESAVER PROM, only a small portion of RAM is needed to store the interface code between BASIC and the PROM routines. Luckily, Imsai has provided a chunk of usable low core. Starting at hexadecimal location 47 is the copyright statement. (My apologies to Imsai, but in a system with limited memory such luxuries cannot be tolerated.) Therefore, the patch shown overlays part of the copyright statement.

To use the Dazzler it is necessary to reserve a 2K section of memory for the display. As mentioned earlier, if you have a section of RAM separated from low core you'll have no trouble. However, in a system with contiguous RAM, there is a problem finding 2K of usable space. Imsai BASIC utilizes RAM from both ends for storing the program and building the data structures.

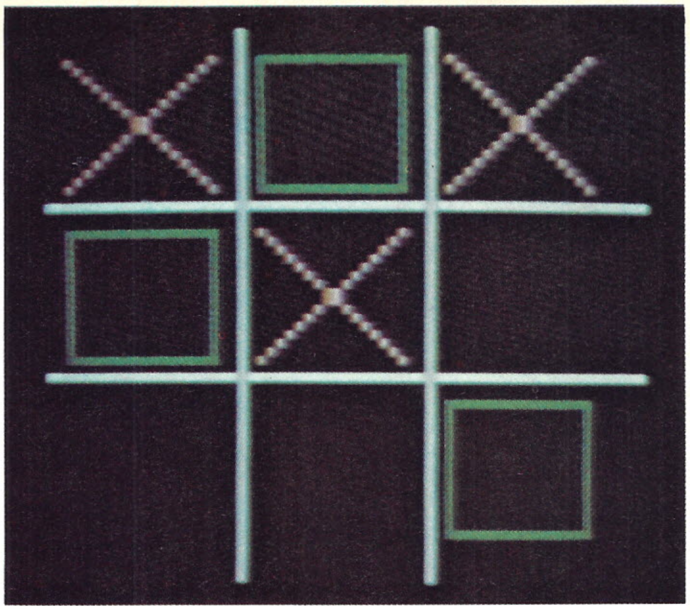
All the available space is left in the middle, where I placed my Dazzler display. Unfortunately, this approach is very much like playing Russian roulette; as the program grows it will either encroach on the TV

```
HEX
LOCATION
47  (Decimal 71)  ROW  DS   1          POKE row number here.
48                COL  DS   1          POKE column value here.
49                DOT  DS   1          Color value here, see fig. 2.
4A 2A 47 00       PLOT LHLD COL        Entry point for plotting is
4D EB                  XCHG            at decimal 74.
4E 21 00 30            LXI  H,AREA     Set up parameters for DAZZ.
51 3A 49 00            LDA  DOT
54 CD C4 FC            CALL DAZZ       You may have the subroutine at
57 C9                  RET             some other location.
58 3E 98          TON  MVI  A,98H      See note with fig. 3.
5A D3 0E               OUT  14         Turn on the Dazzler routine is
5C 3E 30               MVI  A,30H      at location decimal 88.
5E D3 0F               OUT  15         Set mode to 2K, color.
60 C9                  RET
61 AF             TOFF XRA  A          Turn off routine at location
62 D3 0E               OUT  14         decimal 97.
64 C9                  RET
65 21 00 30       CLER LXI  H,AREA     Clear screen at
68 11 00 08            LXI  D,2048     location decimal 101.
6B 36 00          C2   MVI  M,0        Move 2048 zeros to display
6D 23                  INX  H          area.
6E 1B                  DCX  D
6F 7B                  MOV  A,E        Is counter down to zero?
70 B2                  ORA  D
71 C2 6B 00            JNZ  C2         No, keep clearing.
74 C9                  RET
                  DAZZ EQU  OFCC4H     Substitute the address of
                  * your copy of the subroutine.
                  AREA EQU  3000H      A 2K area for the Dazzler
                  * display.  See the note with fig. 3.
```

Fig. 1. Imsai 8K BASIC (Version 1.4) interface routine.

Numeric Value	Color
0	Black
1	Red
2	Green
3	Yellow
4	Blue
5	Violet
6	Blue-green
7	Gray
8	Black
9	Bright red
10	Bright green
11	Bright yellow
12	Bright blue
13	Bright violet
14	Bright blue-green
15	White

Fig. 2. Numeric values for Dazzler colors.



Ticktacktoe.

display or the display will overlay your BASIC program or variables. Aside from this warning, my only other advice is to begin budgeting for that extra RAM in high core.

The patch provides the programmer with four basic functions: (1) turn the Dazzler on; (2) turn the Dazzler off; (3) clear the screen; (4) plot a point of specified color.

For the first three functions, the user need only CALL the proper routine. To plot a point, the programmer must first POKE the XY coordinates and the desired color and then CALL the plotting routine. Fig. 2 lists the values to be POKEd for each different color. The XY coordinates ranging from 0 to 63 are the column value and row value, respectively. For further explanation of the row/column concept, see my earlier article.

To illustrate the interface, the program of Fig. 6 plots the three trig functions in color. If you were to adjust the computations of the SIN curve, it would be possible to plot the ever-popular biorhythm chart. How about your emotional cycle in red, physical in green and intellectual in blue?

Processor Technology 5K BASIC

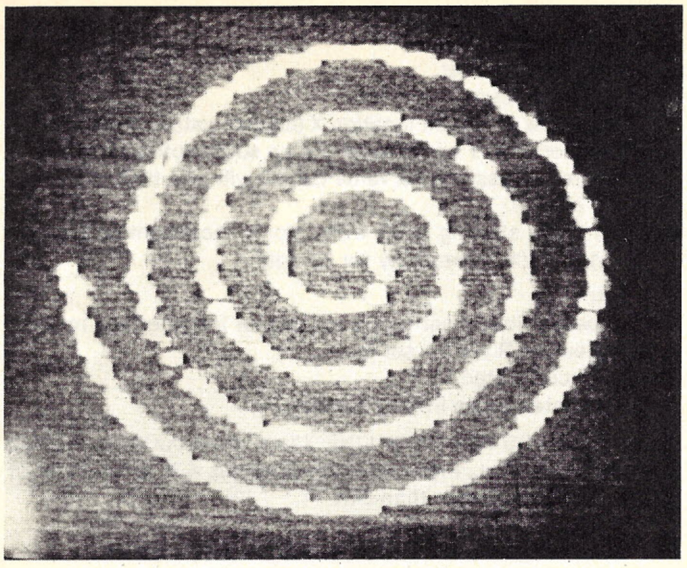
Interfacing with Processor Technology 5K BASIC is more

Fig. 3. Processor Technology 5K BASIC interface routine. (Note: If you want your interface located at some other memory location, all the source lines that reference this note will have to be modified.)

```
PTDAZ  DCR   E        Determine the value of the argument.
       JZ    TON      ARG of one means turn on the Dazzler.
       DCR   E
       JZ    TOFF     Value two means turn it off.
       DCR   E
       JZ    CLR      Three means clear the screen.
       DCR   E
       JZ    PLOT     Four plots a point at XY with color Z.
       DCR   E        Five draws a line starting at XY with
       JZ    LINE     increments of X1, Y1 for Z1 dots.
```

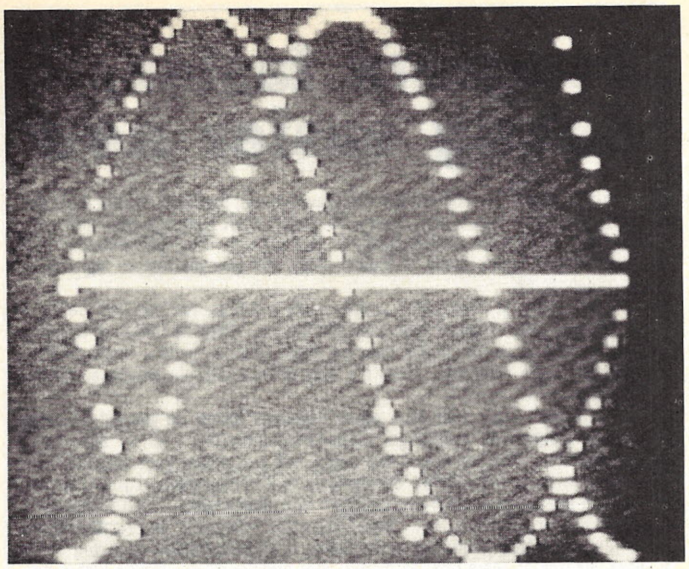
```
        LXI   H,1       Otherwise indicate an error.
        RET
TON     MVI   A,30H     Set mode to 2K with color.
        OUT   15
        MVI   A,0A4H    Turn it on at address 4800H. See note.
XIT     OUT   14
XIT2    LXI   H,0       Indicate normal return.
        RET
TOFF    XRA   A         Turn off the display.
        JMP   XIT
XY      DS    2         Column and row values stored here.
CLOR    DS    1         Color value stored here.
CLR     LXI   H,DAREA   Clear the screen by moving zeros to the
CLR2    MVI   M,0       display area.  This routine is different
        INX   H         from the one in the IMSAI patch and
        MOV   A,H       either one can be used.
        CPI   50H       See note.
        JC    CLR2
        JMP   XIT2      If you want your clear routine to also
* turn on the Dazzler then change this to  JMP  TON.
DAREA   EQU   4800H     See note.
PLOT    MVI   B,'X'     Plot a dot.  First find the value of X.
        MVI   C,0       If you wish to use variable names other
        CALL  LKUP      than X, Y and Z make your changes in this
        STA   XY        routine.  To search for a name like M5
        MVI   B,'Y'     the code would be:
        MVI   C,0                              MVI  B,'M'
        CALL  LKUP                             MVI  C,'5'
        STA   XY+1                             CALL LKUP
        MVI   B,'Z'
        MVI   C,0
        CALL  LKUP
        STA   CLOR
        LHLD  XY        Put row and column values
        XCHG            in the DE registers.
        LXI   H,DAREA   Address of display area in HL
        CALL  DAZZ      Plot the point.
        LXI   H,0       Indicate successful operation.
        RET

* The following code calls on subroutines in BASIC to perform
* a symbol table lookup on the desired variables and convert
* their values to positive integers in the DE registers.
LKUP    CALL  STLK      Find the variable.
        CALL  PSHAS     Put value in the argument stack.
        CALL  PFIX      Convert floating point to fixed.
        MOV   A,E       Use only the low order bits.
        ANI   63        If the variable is not initialized by the
        RET             BASIC programmer it defaults to zero.
DAZZ    EQU   0FCC4H    Adjust  for your system.
```



A Dazzler spiral.

```
STLK    EQU   0C58H      These routines are in 5K BASIC.  Refer
PSHAS   EQU   0CA7H      to its source listing to verify these
PFIX    EQU   0D8AH      addresses.
LINE    CALL  PLOT          Obtain values for X, Y and Z.
        MVI   B,'X'         If you want variable names other
        MVI   C,'1'         than X1, Y1 and Z1, make your
        CALL  LKUP          changes here.
        STA   XINC+1        Value to be added to each X.
        MVI   B,'Y'
        MVI   C,'1'
        CALL  LKUP
        STA   YINC+1        Value to be added to each Y.
        MVI   B,'Z'
        MVI   C,'1'
        CALL  LKUP
        STA   LG+1          Number of dots in the line.
        LHLD  XY
        XCHG                Starting point in DE.
        LXI   H,DAREA       Display address in HL
LINE2   LDA   CLOR          Color in A.
        CALL  DAZZ          Plot next dot.
LG      MVI   A,0           End of the line yet?
        DCR   A
        JZ    XIT2          Yes
        STA   LG+1
XINC    MVI   A,0           Increment the X value.
        ADD   E
        MOV   E,A
YINC    MVI   A,0           Increment the Y value.
        ADD   D
        MOV   D,A
        JMP   LINE2         Next dot.
```



Trig functions.

complicated because of the lack of a POKE command. The authors of that fine interpreter were, however, kind enough to supply several subroutines that perform the same function. If you do not already own a copy of the source listing, I highly recommend acquiring it. If you are not familiar with assembly language, the listing provides many sample routines to study. The listing is commented and, with a little effort, most routines can be deciphered. Also, a source listing will assist you in verifying my Dazzler modifications.

5K BASIC asks for the memory limits at initialization time and is therefore not as destructive of the patches as 8K BASIC. I placed my Dazzler interface and display area in high address RAM and simply confined BASIC to low RAM when it asked for first and last addresses.

The same four functions are implemented in this interface as in 8K BASIC. However, in this case, the CALL statement is always to the same address. The different routines are invoked by passing different values, listed in Fig. 4, to the ARG function. In addition, the interface returns two values also listed in Fig. 4. To plot a point, store the coordinates in

LET R = ARG (A) where the value of A is:

1 Turn on the Dazzler.
2 Turn off the Dazzler.
3 Clear the screen.
4 Plot a point at screen location X (column value), Y (row value) with color Z. X, Y and Z must not be subscripted variables. If they are not assigned a value BASIC will give them a default value of zero.
5 Draw a line starting at XY with color Z, incrementing X and Y by X1 and Y1 respectively for Z1 dots.

R = CALL (S)

S must be previously set to the address of the interface routine. After execution R will be set to:

0 Action completed.
1 ARG contained an invalid number.

If you get an OB ERROR IN LINE XXXX where XXXX is the line number of the CALL, then one of the variables X, Y, Z, X1, Y1 or Z1 was negative or greater than 64K.

Fig. 4. ARG values for the 5K interface.

Name:	STLK Symbol table lookup.
Location:	0C58 (hex).
Input:	Register B contains the alpha portion of the name. Register C contains the numeric portion of the name. If the high order bit of register C is on then the variable is subscripted, i.e., an array name.
Output:	HL points to the table entry. For non-subscripted variables like X and Y the entry contains the Value in floating point notation.
Name:	PSHAS Push argument stack.
Location:	0CA7 (hex).
Input:	HL points to a floating point number.
Output:	The number is pushed into the argument stack.
Name:	PFIX Convert to positive fixed point.
Location:	0D8A (hex).
Input:	Top value in the argument stack. Must be a positive number less than 64K or the OB ERROR message is issued.
Output:	Integer value in the DE registers. The routine also pops the stack, i.e., removes the number from the work area.

Fig. 5. 5K BASIC subroutines and their arguments.

```
0100 CALL 101                          Clear screen.
0200 CALL 88                           Turn on the Dazzler.
0300 FOR A=6 TO 360 STEP 6             Plot every sixth degree.
0400 R=(A+180)*.017453                 Convert to radians.
0500 X=A/6                             Compute X coordinate.
0600 Y=TAN(R)                          Plot the tangent
0700 POKE 73,9                         in bright red.
0800 IF Y > 1 THEN Y=-10               Keep value within
0900 IF Y > -1 THEN GOSUB 3000         the limits of the screen.
1000 Y=SIN(R)                          Plot the sine value
1100 POKE 73,10                        in bright green.
1200 GOSUB 3000
1300 Y=COS(R)                          Plot the cosine value
1400 POKE 73,12                        in bright blue.
1500 GOSUB 3000
1600 POKE 73,7                         Draw a gray horizontal
1700 POKE 72,32                        line for the x axies.
1800 CALL 74
1900 NEXT A                            Draw the rest of the dots.
2000 CALL 97                           Turn Dazzler off.
2100 STOP
3000 POKE 71,X                         Store column number.
3100 Y=Y*32+32                         Adjust row value.
3200 POKE 72,Y                         Store row value.
3300 CALL 74                           Plot it.
3400 RETURN
```

Fig. 6. BASIC program to plot the trig functions.

Fig. 7. Ticktacktoe.

```
010 REM THIS ROUTINE INITIALIZES THE BOARD             1 2 3
020 REM AND TURNS ON THE DAZZLER.                      4 5 6
030 REM SQUARES ARE NUMBERED AS SHOWN HERE.            7 8 9
100 DATA 1,2,3,4,5,6,7,8,9
110 DATA 1,4,7,2,5,8,3,6,9              A table of winning positions.
120 DATA 1,5,9,3,5,7
130 DIM B(9)
140 S=16384                             Location of interface
                                                      routine.
150 FOR I=1 TO 9                        Clear the board.
160 B(I)=0
170 NEXT I
180 R=ARG(3)                            Clear screen.
190 R=CALL(S)
200 R=ARG(1)                            Turn on the Dazzler.
210 R=CALL(S)
220 Z=7; X=20; Y=0                      Draw TIC TAC TOE board.
230 Z1=64; X1=0; Y1=1
240 R=ARG(5)
250 R=CALL(S)                           Left vertical line.
260 X=40
270 R=CALL(S)                           Right vertical line.
280 X=0; Y=20
290 X1=1; Y1=0                          Top horizontal line.
300 R=CALL(S)
310 Y=40
320 R=CALL(S)                           Bottom horizontal line.
330 Z=1                                 Set to player one.
340 R=ARG(4)                            Set to plot mode.
400 REM THE FOLLOWING ROUTINE ASKS FOR THE PLAYER'S MOVE,
410 REM RECORDS IT AND DETERMINES WHO MOVES NEXT.
500 PRINT "ENTER MOVE ?",
510 INPUT ,M
520 IF M = 0 THEN 600                   A zero skips player's move.
530 IF M < 1 THEN 500                   Validate the move.
540 IF M > 9 THEN 500
550 IF B(M) <> 0 THEN 500
560 B(M) = Z                            Record the move.
570 GOSUB 3000                          Compute screen location.
580 IF Z=1 THEN GOSUB 4000              Draw an X for player one
590 IF Z=2 THEN GOSUB 5000              and an o for player two.
600 Z=Z+1                               Next player.
610 IF Z > 2 THEN Z=1
620 GOSUB 6000                          Check for winner.
630 IF Z=1 THEN GOTO 500                Whose move?
640 GOSUB 1000                          Machine moves.
650 GOTO 560
0900 REM THIS ROUTINE COMPUTE'S THE MACHINE'S MOVE
1000 IF B(5)=0 THEN M=5;  RETURN        Always take the middle.
1010 M=0
1020 FOR I=1 TO 8                       See if I can win in
1030 READ A,B,C                         one move.
1040 IF B(A)=1 THEN 1200                Check to see if opponent
1050 IF B(B)=1 THEN 1200                is blocking a win.
1060 IF B(C)=1 THEN 1200
1070 IF B(A)+B(B)=4 THEN M=C            See if I am in 2 out of
1080 IF B(A)+B(C)=4 THEN M=B            3 of the squares.
1090 IF B(B)+B(C)=4 THEN M=A
1100 IF M<>0 THEN IF B(M)<>0 THEN M=0   Is it a legal move?
1200 NEXT
1300 RESTORE
1400 IF M<>0 THEN RETURN                I found a winning move.
1410 FOR I=1 TO 8                       See if I must move to
1420 READ A,B,C                         block opponent's win.
1430 IF M<>0 THEN 1480                  Already found a move.
1440 IF B(A)=1 THEN IF B(B)=1 THEN M=C
1450 IF B(A)=1 THEN IF B(C)=1 THEN M=B
1460 IF B(B)=1 THEN IF B(C)=1 THEN M=A
1470 IF M<>0 THEN IF B(M)<>0 THEN M=0   Is third square empty?
1480 NEXT
1490 RESTORE
1500 IF M<>0 THEN RETURN
1510 IF B(9)=0 THEN M=9; RETURN         Try for a corner.
1520 M=INT(RND(0)*8+1)                  Pick a random square.
1530 IF M < 1 THEN M=1
1540 IF M > 8 THEN M=8
1550 IF B(M) <> 0 THEN 1520             Is it empty?
1560 RETURN
2000 REM THE FOLLOWING ROUTINE COMPUTES THE XY COORDINATES
2100 REM OF THE SELECTED MOVE.
3000 Y=INT((M-1)/3)*20+18
3010 X=M
3020 IF X > 3 THEN X=X-3
3030 IF X > 3 THEN X=X-3
3040 X=(X-1)*20+2
3050 RETURN
3060 REM THE FOLLOWING ROUTINE DRAWS A LINE FROM XY IN
3070 REM DIRECTION X1 Y1.  IT PROVIDES THE SAME FUNCTION AS
3080 REM OPTION FIVE OF THE INTERFACE BUT IS SLOWER AND HAS
3085 REM A MORE AESTHETIC APPEARANCE.
3090 Z1=16
3100 R=CALL(S)
3110 Z1=Z1-1
3120 IF Z1 < 1 THEN RETURN
3130 X=X+X1
3140 Y=Y+Y1
3150 GOTO 3100
3500 REM THE FOLLOWING ROUTINE DRAWS AND X AT LOCATION XY
4000 X1 = 1                             Diagonal line from
4010 Y1 = -1                            lower left to upper right.
4020 GOSUB 3090
```

```
4030 X=X-15                          Diagonal line from upper
4040 Y1 = 1                          left to lower right.
4050 GOTO 3090
4500 REM THIS ROUTINE DRAWS AN O AT LOCATION XY.
5000 Y1=0; X1=1                      Draw a box.
5010 GOSUB 3090                      Across the bottom.
5020 Y1 = -1; X1 = 0
5030 GOSUB 3090                      Up the right side.
5040 Y1 = 0; X1 = -1
5050 GOSUB 3090                      Back across the top.
5060 X1 = 0; Y1 = 1
5070 GOTO 3090                       Down the left side.
5900 REM THIS ROUTINE DETERMINES IF THERE IS A WINNER.
6000 FOR I=1 TO 8                    Look at all combinations.
6010 READ A,B,C
6020 IF B(A)=0 THEN 6050             Empty square means no win.
6030 IF B(A) <> B(B) THEN 6050       Unlike squares indicates a
                                                         block.
6040 IF B(A) = B(C) THEN 6120        We have a winner folks!
6050 NEXT
6060 RESTORE
6070 I=1                             Are there any empty squares
6080 IF B(I)=0 THEN RETURN           left on the board?
6090 I=I+1; IF I < 10 THEN 6080
6100 PRINT "GAME ENDS IN A TIE"
6110 STOP
6120 IF B(A)=1 THEN PRINT "X WINS"
6130 IF B(A)=2 THEN PRINT "O WINS"
6140 Z1=64; Z=4; X=0                 Draw line thru winner.
6150 X1=1; Y1=0; Y=I*20-10           Horizontal line values.
6160 IF I > 3 THEN X1=0; Y1=1; Y=0; X=(I-3)*20-10 Vertical line
                                                        values.
6170 IF I > 6 THEN X1=1; X=0         Slant right.
6180 IF I > 7 THEN X1=-1; X=63       Slant left.
6190 GOSUB 3100                      Draw it.
6200 STOP
```

the two non-subscripted variables X and Y. The color value (see Fig. 2) is placed in the variable Z. Next, set the ARG function to the value four and issue the CALL.

The interface uses three subroutines in the BASIC interpreter to simulate the POKE command. The arguments and functions of the three routines are given in Fig. 5. For each argument (X, Y and Z), the interface calls on STLK (an acronym for Symbol Table LooKup, I suppose) to locate the argument in the symbol table. PHAS (PusH Argument Stack) then places the value in BASIC's argument stack, or work area. Finally, PFIX (this one really has me going; perhaps it means Positive FIXed point conversion) takes the top item in the argument stack and converts it to a 16-bit positive integer.

This interface provides one additional function beyond the four already mentioned: a line-drawing routine. Since assembly-language programs are more efficient than their BASIC counterparts, and because many graphic applications need straight lines (such as histograms and bar charts), this fifth function seems desirable. In addition to X, Y and Z, which specify the starting point and color of the line, the user must supply three values in the non-subscripted variables X1, Y1 and Z1. For each successive line point, the value of X1 is added to the previous X and Y1 to the previous Y. Z1 determines the number of points in the line. The interface does not modify any of the variables.

In order to draw an upward- or leftward-moving line with option five, it is necessary to specify a negative number in one or both of the variables X1 and Y1. Any negative number, however, causes an OB ERROR message. Since the interface uses only the low-order eight bits of each number, it is possible to pass a negative number as the eight-bit two's complement.

For example, if you want Y1 to take on the value minus one, you simply set it to 255 (i.e., LET Y1 = 255). For minus two, use 254; minus three, 253; and so on.

The interface functions are illustrated in the Ticktacktoe program of Fig. 7. This version is beatable and, therefore, more satisfying to play. (A few modifications allowing it to anticipate forks would make it unbeatable.)

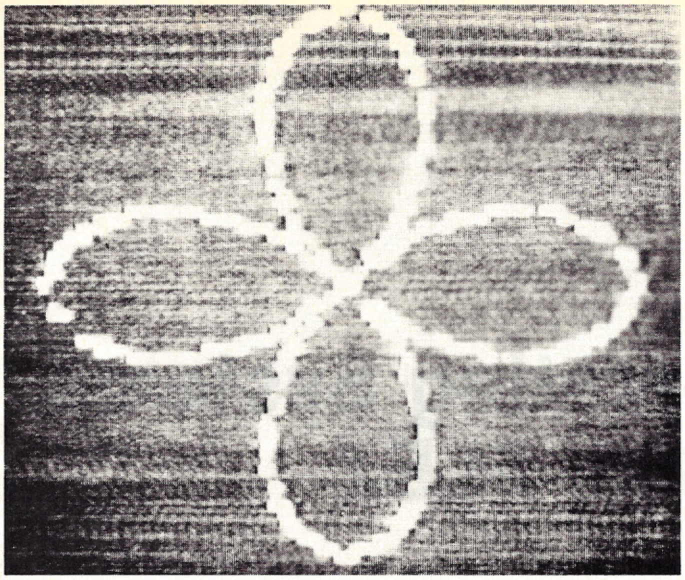
After developing and testing (another word for playing) these interfaces it is necessary to discuss speed. The Dazzler subroutines DAZ and DAZZ appear to operate reasonably fast in assembly-language programs. However, with the added overhead of BASIC, the graphics are noticeably slower. This is the primary reason for the clear-screen and line functions.

Also, because of the DMA (direct memory access) action of the Dazzler, all your programs will run 15 percent slower. Therefore, I recommend that the Dazzler be turned off when not required. (The picture data in memory is not lost when the Dazzler is off and will reappear on the screen when the Dazzler is turned on again.)

I hope these interfaces will allow more hobbyists to use this exciting computer periph-

Fig. 8. A program to plot equations in polar coordinates.

```
1000 L=360                           Limit the plotting.
1010 S=16384                         Address of the interface.
1020 M=0                             Maximum X or Y.
1030 R=ARG(2); R=CALL(S)             Turn Dazzler off.
1040 FOR A=6 TO L STEP 6             Find largest X or Y.
1050 GOSUB 4990
1060 X=R*COS(T); Y=R*SIN(T)          Convert polar to rectangular
1070 IF ABS(X) > M THEN M=ABS(X)     coordinates.
1080 IF ABS(Y) > M THEN M=ABS(Y)
1090 NEXT
1100 R=ARG(3); R=CALL(S)             Clear the screen.
1110 R=ARG(1); R=CALL(S); R=ARG(4)   Turn on and set plot mode.
1120 M = (M+M/32)/32
1130 FOR A=1 TO L                    Plot each point.
1140 GOSUB 4990
1150 X=R*COS(T)/M+32                 Convert from polar coordinates
1160 Y=R*SIN(T)/M+32                 to a point on the screen.
1170 Z=RND(0)*14+1                   Random color, avoid zero (black).
1180 R=CALL(S)
1190 NEXT
1200 STOP
4990 T=A*.017453                     Convert to radians.
5000 REM INSERT DESIRED EQUATION HERE
5100 RETURN
```



Four-leaf rose.

To plot a figure, replace the REMARK in line 5000 of figure eight with the desired equation.

R=2*(1-2*SIN(T))	Limaçon
R=4*SIN(3*T)	Three leaf rose
R=2*COS(2*T)	Four leaf rose
R=2-SIN(T)	Limaçon
R=5	Circle
R=A/10	Spiral, also change line 1000 L = 1440 and line 1040 FOR A 1400 TO L STEP 6. This one takes several minutes.

Fig. 9. Some suggested formulas for the program of Fig. 8.

eral and to write more Dazzler programs. The book *101 BASIC Computer Games* contains programs that might have possibilities for color output.

Perhaps someone could write a battleships game, a dogfight game using Cromemco's new joysticks, a better lunar lander complete with retro-fire and flying debris, or perhaps another Star Trek. Other applications could include graph plotters, animated pictures, bar charts and psychedelic light shows.■

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The Latest in Operating Systems for the 6800: FLEX

As Mickey Ferguson points out, this may well be the answer to CP/M for 6800 owners.

When you read my review of the Southwest Tech MF-68 minifloppy disk system in the April issue of *Kilobaud* (you did read it, didn't you?), you probably did not expect to see another article about the MF-68 for a while. Well, I certainly didn't plan to write one so soon, and I doubt if *Kilobaud* planned to publish one. But, Southwest Tech has done a most unexpected, surprising thing. They've joined with Technical Systems Consultants to produce an entirely new disk operating system (DOS), FLEX, and a new extended disk BASIC.

FLEX is probably the most important new piece of software for the 6800 since Robert Uiterwyk wrote SWTP BASIC! FLEX has the potential of becoming for the 6800 what CP/M has become for the 8080: the universal disk operating system!

Perhaps FLEX sounds like a strange name for a DOS, but it is so totally flexible that no other name is appropriate. FLEX is currently being delivered with both Southwest Tech's minifloppy and their full-size disk systems; though FLEX for the full-size system has even more features than the minifloppy version discussed here. TSC says they could provide FLEX for any 6800 floppy-disk system, but *only* OEMs need apply.

As this is written (in late March) FLEX has been officially available for less than a week, but I have already heard of users modifying it to run on Sphere systems and Altair 680s. And at least one independent software house (Computerware) is offering a disk BASIC designed to run under FLEX (more on this later). And there is already talk of a FLEX User's Group! (Write TSC for info.)

Remember that I have the minifloppy disk system, so this discussion will be centered around that version of FLEX. In those cases where I know the differences between the two versions of FLEX, I will point them out.

A Most Flexible DOS

The FLEX operating system is composed of three parts—the file management system, the disk operating system and the utility command set. Some of the more important features of FLEX include: fully dynamic file space allocation with uniform disk wear as a result, the automatic "removal" of defective sectors from disk (after determining that a sector is bad, FLEX ignores that sector and will not store any information on it) and automatic space compression and expansion of all text files for more efficient use of disk space.

Fig. 1 shows examples of file names and extensions usable with FLEX. It is interesting to note that a file name may appear many times on the same disk as long as the extensions are different. Fig. 1 lists only the default extensions, but you may assign any extension you desire to a file.

The minimum memory requirements to use FLEX are twelve kilobytes addressed from 0 through \$2FFF and four kilobytes from \$7000 through \$7FFF. FLEX normally uses the memory beginning at \$7000 for the operating system itself (FLEX for the big disk system is assembled for \$A000 instead of \$7000) plus part of page 0 for temporary storage. Some of the utility commands use memory through \$2FFF. The FLEX operating system resides in approximately 14 kilobytes of disk space, though only about four kilobytes are actually in memory at any one time since FLEX works in overlays.

There are only two commands that are always in memory whenever the FLEX operating system is in use; these are GET and MON. GET loads a file from disk to memory and MON turns system control over to your monitor ROM. The remainder of the commands comprise the utility command set (UCS) and are normally on disk, not in memory.

Fig. 2 is a list of the UCS supplied with FLEX. You will notice the lack of a RUN command in either FLEX or the UCS. None is needed because FLEX will load and run machine-executable programs whenever you type their file names.

In this respect, the UCS commands are like any other programs. However, the UCS commands are usually loaded into an area of memory inside FLEX whenever they are called. This is what I meant when I said that FLEX works in overlays.

On the surface, the only advantage to using overlays might appear to be conserving memory space with a small loss of speed when compared to having the UCS functions resident in memory. However, it has several additional advantages. For example, new or improved commands can be added at any time without replacing the entire DOS, only the af-

NAME	EXTENSION	DEFINITION
DOS	.SYS	SYSTEM FILE
APPEND	.CMD	COMMAND FILE
KLINGON	.BIN	BINARY FILE
EXAMPLE	.TXT	TEXT FILE
STARTREK	.BAS	BASIC PROGRAM FILE
temp	.DAT	BASIC DATA FILE
EXAMPLE	.BAK	BACKUP FILE

Fig. 1. Two of the above files have the same name but different extensions and may, therefore, reside on the same disk. The above are extensions FLEX and software running under FLEX will normally assign. You may use any three character extensions you desire in addition to these. File names may be any combination of alphanumeric characters up to eight characters in length.

fected command. This is one of the things that gives FLEX its flexibility. You can expect to see many more commands available for FLEX in the future from TSC and other sources (probably including *Kilobaud* articles).

The UCS

A thorough discussion of FLEX's utility command set is impossible in an article such as this because of the number of the UCS commands, as well as the complexity of some of them (see Fig. 2 for a list of the UCS commands). They are very well documented in the FLEX User's Guide provided with FLEX by Southwest Tech. Incidentally, the FLEX User's Guide is at least an order of magnitude better than any previous documentation provided by Southwest Tech for any of their products. Anyway, I will attempt to tell you a little about a few of the UCS commands.

ASsigN and TTYSET are two commands with which the new user should initially acquaint himself. The ASN command lets the user designate which drive is to be the system drive and which drive is to be the working drive. FLEX assumes that the system drive contains the UCS and all system software, such as BASIC. The working drive is the one FLEX assumes contains all applications programs and files.

I have said "FLEX assumes" because in all cases you may explicitly specify the drive to be used and thus override the assignments. If you have drive one assigned as the system drive and drive zero assigned as the working drive and you type CAT, FLEX will go to drive one to fetch the UCS command CAT and then use CAT to print the catalog of the files on drive zero.

The TTYSET command allows the user to modify FLEX for compatibility with the characteristics of his terminal. These characteristics include the character FLEX recognizes as a back space, line delete, end of line (for multiple statement command lines) and break. Also, TTYSET allows you to set FLEX for your terminal's line length and number of lines per page. You may also specify half or full duplex, the number of nulls to be output after a carriage return/line feed sequence and the number of lines to skip before starting a new page. You may also turn the paging feature on or off.

TSC recommends that you use the I/O routines in FLEX instead of your monitor ROM's I/O routines in the programs that you write; this allows most of the TTYSET characteristics to be passed on to your programs. Using FLEX's I/O routines has the additional benefit (for software vendors, such as TSC) of allowing software to be machine independent—that is, a program written to run under the FLEX operating system could be used on an SWTP 6800, a Mits Altair 680, a Sphere or what have you without any modification to the program!

The UCS command COPY deserves special mention because of its tremendous flexibility. It allows files to be copied from any drive to any other drive. You may choose to copy either the entire disk or selected files by file name, file type or any other characteristic unique to a file or group of files. This is convenient when you wish to copy data files only, or BASIC programs only, or even if you simply want to arrange the files in alphabetical order.

There is another variation of the COPY command in the UCS called COPYNEW. It is a terrific time-saver because COPYNEW copies all files from disk A to disk B that did not already exist on disk B.

I believe it is a good idea to periodically copy your disks because of one of the features of FLEX. FLEX uses *dynamic file space allocation*, which, as I understand it, means that FLEX will store files wherever space is available on the disk—a sector here, a sector there and a few sectors somewhere else. This is good because no sectors are wasted and your disks can really be packed with information.

APPEND	DELETE	P
ASN	EXEC	RENAME
BACKUP	JUMP	SAVE
BUILD	LINK	SAVE.LOW
CAT	LIST	TTYSET
COPY	MEMTEST1	VERIFY
COPYNEW	NEWDISK	VERSION

Fig. 2. FLEX's utility command set. These commands, though a part of the operating system, are normally on disk, not in memory. They are called from disk only when needed. As a result, new commands may be added at any time, and commands may be renamed to suit your personal preferences.

However, an old disk that has had many files added and deleted can have files literally scattered all over the disk, resulting in drastically increased file access times. When files are copied, all files are grouped in contiguous sectors, thus reducing the file access time.

In this limited discussion of the UCS, I've saved the best for last! And the best is the tremendous additional power given to FLEX by the UCS commands, BUILD, EXEC and LIST. The BUILD command works like a rather limited text editor in that it allows the user to enter text files directly from the control terminal. It is limited because each line is transferred to disk as it is entered and is, therefore, not available for editing from BUILD.

```
NEWDISK,1
COPY,0,1,.CMD,.OV,.LOW,.SYS
LINK 1,DOS
```

Fig. 3. A typical FLEX "macro" file. See text for full explanation.

The text files entered from BUILD can be BASIC programs, BASIC data files or any other type of text file that you desire. The UCS LIST command is like the inverse of BUILD as it allows selected files to be output to the terminal for viewing by the user.

The EXECute command allows text files to be processed as lists of commands! Think about that for a moment! I've never been accused of being exceptionally bright so it took a while for me to fully realize the capability the EXEC command adds to FLEX. I like to refer to this as FLEX's "macro" capability. My wife, the resident IBM

freak at our house, says this is more like a function of the Job Control Language on the big IBM systems.

Whatever you call it, the EXEC command, properly used, does allow "hands off" control of batch processing by FLEX. Fig. 3 is a simple example of an executable text file and is used in the FLEX User's Guide to illustrate this function. It is a macro that would be used to create new systems disks.

The NEWDISK,1 command tells FLEX to initialize the disk in drive number one. The next line of the macro tells FLEX to copy all files with extensions of .CMD, .OV, .LOW and .SYS from the disk in drive number zero to the disk in drive number one. Finally, the LINK,1.DOS command tells FLEX to modify the bootstrap loader on the new disk so it will know where the DOS is located on the disk. It is necessary to link the bootstrap loader to the DOS because the location on the disk where DOS resides can change from disk to disk. This entire sequence is performed whenever the file shown in Fig. 3 is EXECuted.

Not only is the macro capability of FLEX a super timesaver, but it also greatly expands the power of the operating system. The possibilities opened by the UCS EXEC command are limited only by your imagination in applying them!

I have had no problems with the FLEX operating system and have found it to be remarkably bug-free for a brand-new piece of software. However, I have heard a lot of complaints from FLEX users who use the SWTBUG monitor. The problem occurs only when the user has an ACIA serial interface on the control port and appears, when user machine-language programs are run, as a double echo on all characters typed from the control terminal. The user is warned about this in the FLEX User's Guide and advised, regardless of the monitor used, to use the I/O routines in FLEX rather than the ones in his own monitor.

While this sounds reasonable enough, it too is the source of more complaints. Many people have programs from various sources for which they do not have sufficient documentation to allow the programs to be safely modified. Also, many programs use routines commonly found in the monitor ROMs, but not in FLEX, or if they are in FLEX, they are not documented in the FLEX User's Guide. To those people who are using SWTBUG with an ACIA interface and FLEX, this is a very large problem, and one that SWTP/TSC should look into, particularly since SWTP sells both SWTBUG and FLEX.

Unfortunately, those people at SWTP and TSC with whom I've discussed this problem seem totally unconcerned. Since I do not have the SWTBUG monitor in my system, I shouldn't really comment further on this problem. To those having difficulties with FLEX due to the use of SWTBUG, I suggest the purchase of the *FLEX Advanced Programmer's Manual,* which is available from SWTP for $20.

As a sort of footnote to the discussion of FLEX, I would like to relate to you the following, which a computer store owner told me. It seems he has a customer who is in charge of data processing for a large government agency. Knowing his customer's experience, the dealer asked for his comments on FLEX. The customer startled the dealer by replying, "If this is the DOS that comes with the Southwest Tech disk system, I'll take one. I can't get anything this good from IBM!"

SWTP Disk BASIC Version 3.0

The BASIC provided with FLEX by SWTP is essentially the one SWTP users have had since the introduction of 8K BASIC Version 1.0. So, most of its commands and statements are already familiar to most SWTP owners. Features such as nine-digit precision BCD arithmetic, selection of fixed or floating decimal, its ability to work with four serial and four parallel I/O devices, etc., are all still there, although some things work differently than before (more about this in a moment). Disk BASIC Version 3.0 now has disk save, load *and* append commands, as well as tape save, load and append; also, additional commands/statements have been added to allow BASIC to work with sequential disk data files.

I must admit to being disappointed that random access data files were not supported by this BASIC, until I learned why only sequential access data files were chosen. Random access files are wasteful in their utilization of disk space, which is at a premium on minifloppy disks. Random access files are available with the BASIC for the SWTP DMAF1 full-size floppy disk system, which has over one million bytes of on-line storage, compared to the 150,000 or so with the dual drive minifloppy system.

The additional disk commands/statements of Disk BASIC 3.0 are: CAT (short for catalog), CHAIN, KILL, RENAME, OPEN, CLOSE, READ, RESTORE, WRITE, SCRATCH, and the function EOF(n). Most of these commands are self-explanatory to anyone who has been exposed to BASIC, and are very easy (even for me) to learn to successfully use for easy data-file manipulation.

SCRATCH is the only disk command/statement whose meaning could be ambiguous. SCRATCH first deletes the specified file then reopens the file so data can be written to it. I do wish they would have chosen to use DELETE (or something similar) instead of KILL for deleting files. KILL sounds so final and rather violent. The CHAIN statement now allows you to call one BASIC program from another BASIC program and specify the line number where you wish the CHAINed program to begin execution . . . a very nice feature.

SWTP Disk BASIC allows a maximum of ten files to be open at any one time, which should be enough for almost any application. Also, in my experience, all of the file-handling features perform flawlessly; which is quite amazing since this is the first version of BASIC from SWTP with data file capability.

Gripe Time!

As already mentioned, the data file features of SWTP BASIC work quite well; unfortunately, I cannot say as much for some of the other changes. In each and every version of SWTP BASIC since 8K Version 1.0, the LINE= command has been used to set the maximum line length in PRINT statements. In all previous versions, you have been able to disable this feature for precise program control of printing by using LINE=0. Most unfortunately, in the new version LINE=0 sets the line length to that established by the TTYSET command in FLEX.

As a result, most of my library of BASIC programs (and probably yours, too) will not run correctly with this version of BASIC. Also, the paging feature of FLEX is carried over to BASIC with, sometimes, disastrous results.

The paging is quite welcome when you are listing a BASIC program because the program will be listed until your CRT is filled. It is then halted until you press ESCape, then another CRT full is listed, etc. This is anything but nice when you are actually running your programs because the program will appear to just hang up at odd times, giving the impression BASIC has bombed! If this feature (?) is to be carried over from FLEX to BASIC, the user should have the option of turning it on or off at will. Presently, there is no provision for doing so without returning to FLEX.

This version of BASIC expects a Bit-Banger serial interface on port zero, while *all previous versions* have used an ACIA-type serial interface on this port. I have a serial terminal connected to an ACIA on port zero and have a fair amount of software written for this configuration. I configured the hardware and software in my system like this as a direct result of the conventions established by SWTP BASIC, and I seriously doubt that I am

the only one to do so.

Perhaps my complaints about SWTP BASIC sound petty . . . but it is a major irritant to discover that the library of software you have amassed over a period of time for SWTP BASIC will not run properly with the latest version of their BASIC! They have suddenly changed many of the conventions which they established with their first BASIC and to which they have adhered for a considerable period of time. Incidentally, I have only mentioned a few of these changes; there are numerous others.

Other Software

As I mentioned toward the beginning of this article, Computerware has a disk BASIC available to run with the FLEX operating system. It looks very good and appears to have some very desirable features. I can offer little more information than this about Computerware's BASIC because it will not run on my system since it *requires* the SWTBUG monitor. Strangely, that is not mentioned in either Computerware's advertising or documentation.

TSC is providing considerable software support for FLEX, offering FLEX versions of their text processor, assembler and super editor. Since TSC wrote FLEX, it is the only disk operating system for which they plan this type of support. Even if you're not interested in their assembler or text processor, TSC's editor is probably the best investment you can make in software once you have FLEX for your system. You have only to read the advertisements in this (or almost any other) computer magazine to realize TSC's editor is the standard of comparison for text editors, and most disk system manufacturers are offering patches to allow the TSC editor to be used with their DOS.

Well, FLEX was apparently the operating system TSC had in mind when they wrote their editor; the FLEX version really does everything! With it you can edit source files for the assembler and text processor, and you can edit BASIC programs and data files as well. But don't tell everyone that I told you it can be used to edit data files because they seem to be trying to keep it a secret. It isn't mentioned anywhere in any of the documentation I have from SWTP or TSC.

The FLEX versions of TSC's assembler and text processor are also very good. And they, like the editor, use disk space like additional memory so you can do as much work with a 16K minimum system as you can with a fully expanded super system.

I think this is only the tip of the iceberg as far as FLEX-based software is concerned, and, in the future, most of the better 6800 software will be written for systems using FLEX. For example, TSC's long-rumored "Super BASIC" compiler should be available by the time you read this. I've also heard SWTP is planning a multiuser version of their disk BASIC, and Microware is rumored to be developing a version of their ultrafast A/BASIC compiler for FLEX systems.

The End, Finally!

In conclusion, let me again state that I think FLEX is a true landmark in 6800 software and could just be the single most important piece of software yet developed for 6800 systems. When I asked Don Meyer, president of SWTP, for his comments concerning FLEX, he said, "We feel that our customers have always had the best, most reliable microcomputer hardware available and now they should have to apologize to no one for their software." To that I can only add Amen!

Oh! I almost forgot to tell you how much SWTP is charging for FLEX and BASIC Version 3.0! They're not charging anything! It's free to all MF-68 owners. ■

Ed Juge
2000 Thousand Oaks Dr.
Burleson TX 76028

This program with an instruction program is available from Kilobaud's Instant Software. See the Instant Software ad in this issue.

Action on the Enterprise

There are many computerized space-battle games around, but few are as much fun or as challenging as this 4K version for the Radio Shack TRS-80.

Space Trek is one of the most interesting games available for microcomputer hobbyists; it's considered a classic. I've played one version on a large business computer, seen a printout of another version from a minicomputer operated by a school system, and played still another version on a microcomputer.

My own hobby computer, the TRS-80 by Radio Shack, is a relatively new product. It became apparent that if I wanted to play Space Trek at home, I would have to write it myself, as no such game was currently available for the TRS-80.

To make the game useful for other TRS-80 owners, I wanted it to work with Level I BASIC and the 4K RAM configuration. If you've ever played a good Space Trek game, you know that it is fairly involved, so writing it for the 4K machine presented a challenge.

The game had to offer some difficulty; it had to include a visual display of the current space sector and all objects in that sector, and it had to show the action of the Enterprise's phaser and photon torpedo weapons, and, of course, the Enterprise's movements.

It required some protection against cheating by the operator . . . shooting stars out of the way easily, etc., and certainly it had to display power levels for various systems. I wanted the instruction codes to be as simple as possible, yet really didn't want everything coded in by numbers.

As the program took shape, it became obvious that it would have to make use of the TRS-80's programming abbreviations and command stacking to the greatest possible extent to conserve memory and stay within the 4K machine capabilities.

If this program is typed into memory from the program listing, abbreviations must be used, and extra spaces avoided like the plague. With the program properly entered, 299 remaining words of memory are indicated, but the memory map array requires 269 words, so the actual unused memory is only 30 words!

The first completed version worked fine. As I watched some friends operate it, however, some common areas of cheating became apparent. I went back to the drawing board and squeezed, wrung and pounded the existing program until I found room for some safeguards to prevent the most common of these practices.

When modifications were completed, things looked much better. Several hours' work with a friend playing it resulted in some changes to power used by various systems; as it stands now, you can win only if you avoid making any mistakes.

There will be times, though, when you will lose simply because a starbase didn't show up at the proper time and in the proper sector for refueling. Your decisions as to when to vacate a Klingon-infested sector for self-preservation and your ability to make advantageous impulse power moves within a sector are of primary importance.

This version of the game can be won almost every time *only* by the most skillful and careful players. This degree of difficulty was intentional, as was the occasional loss due to that elusive starbase. For anyone who wants to have a little easier time of it, the following changes can be made.

1. Starbase appearances are a one-out-of-three chance now. To increase the chances to two out of three, change line 355 to read:

```
355 J=RND(3):IFJ=1T.360
```

This one change should virtually eliminate those impossible-to-win situations for the skillful player.

2. Power levels of various systems are established in line 500. Although the program refers to percentage of system power, it is possible to adjust line 500 for several hundred percent of any system power level you like. It is much easier to increase available power in this manner than to cut the power used for various moves; the latter involves changes in two or more program lines for each system changed. Power levels, set in line 500, are:

A(65)—Impulse power remaining.
A(66)—Warp power remaining.
A(67)—Phaser power remaining.
C—Shield power remaining.
K—Number of torpedoes available.

If you wish to make a power change permanent, and you're offended by more than 100 percent of system power, go into lines 130, 140, 150 and 170, and substitute blank spaces for the % characters.

With the list of variables,

10 -100	INITIALIZES VARIABLES AND SETS INSTRUCTION CODE VALUES.
120-210	SETS UP VIDEO DISPLAY FOR THE GAME (OTHER THAN SCANNER DISPLAY AND VARIABLES).
290	INITIALIZES A( ) ARRAY . . . MEMORY MAP OF SECTOR SCANNER.
300	SELECTS RANDOM NUMBER OF KLINGONS & STARS (TOTAL).
310	LOOKS FOR AN OPEN SECTOR POSITION.
320-330	PLACES KLINGON OR STAR (RANDOM) IN THE OPEN POSITION.
325	COUNTS THE NUMBER OF KLINGONS IN THIS SECTOR.
332-336	DECIDES ON A 'BLACK HOLE' AND WHAT IT WILL DO IF SHOT.
340	LOCATES AN OPEN SECTOR FOR THE ENTERPRISE.
350	SETS THE ENTERPRISE'S LOCATION IN THE MEMORY MAP ARRAY.
355-357	DECIDES AT RANDOM (1 OUT OF 2 CHANCES) IF THERE WILL BE A STARBASE IN THIS SECTOR, AND IF SO PLACES IT IN MEMORY MAP.
360-390	DRAWS SPACE SECTOR ON SECTOR SCANNER FROM MEMORY MAP.
490	TESTS FOR 1. NEW PROGRAM, 2. WARP INTO NEW SECTOR, 3. REDRAW. IN 2 OR 3 ABOVE, JUMPS POWER RESET LINE.
500	SETS POWER LEVELS TO MAXIMUM.
600-660	SUBROUTINE STORAGE AREA.
690	VERIFY DOCKING WITH STARBASE, IF SO, REFUEL.
695	RE-ESTABLISH X-Y COORDINATES.
700-710	PRINT UPDATED GAME TOTALS AND CHECK FOR WIN.
711	CHECK FOR LOST GAME . . (SHIELD POWER TO 0, SHIP DESTROYED.)
720	INPUT INSTRUCTION CODES FOR INSTRUCTION, DIRECTION, DISTANCE.
721	CHECK FOR COMMAND TO REDRAW VIDEO DISPLAY.
722	CHECK FOR ATTEMPT TO FIRE TORPEDO LATERALLY (NOT ALLOWED).
725	CHECK FOR WARP DRIVE . . . IF NOT, REGISTER 4% SHIELD POWER LOSS FOR EACH REMAINING KLINGON VESSEL IN SPACE SECTOR.
730	DIRECT PROGRAM TO PROPER SUBROUTINE FOR INSTRUCTION CODE GIVEN.
740-810	DISALLOWS USE OF MORE THAN REMAINING AVAILABLE POWER, AND SUBTRACTS POWER USED FOR INSTRUCTION GIVEN. BRANCHES PROGRAM TO PROPER SUBROUTINE FOR DIRECTION CODE GIVEN.
	-----IMPULSE POWER MOVES-----
1110	UP
1210	DOWN
1310	RIGHT
1410	LEFT
1510-1530	SUBROUTINE FOR IMPULSE POWER MOVES.
	-----FIRE PHASERS-----
2050-2110	UP
2150-2210	DOWN
2250-2310	RIGHT
2350-2410	LEFT
2500-2590	PHASER SUBROUTINE FOR MOVEMENT IN Y-AXIS
2600-2695	PHASER SUBROUTINE FOR MOVEMENT IN X-AXIS
	-----FIRE PHOTON TORPEDOES-----
2700-3120	UP
3150-3220	DOWN
3500-3540	TORPEDO MOVEMENT ROUTINE
4000-4040	SHOOT THE 'BLACK HOLE' ROUTINE
5000-5003	FIND X,Y, AND PRINT AT A, GIVEN POSITION NUMBER

Table 1. Space Trek operation outline.

description of operation and full program listing, you should be able to follow the program easily enough to make minor changes at will. Remember, however, that if your TRS-80 is a 4K machine, you have almost no available room to add statements, unless you can delete something elsewhere. Your 4K machine allows 299 words of unused memory, but the A(1) to A(67) array will use 269 of those words, cutting the ball game awfully close.

Because of lack of available memory, instructions were not included. I wrote a second program that includes a novel introduction, and a graphics title display complete with a picture of the Enterprise on the video screen. I got somewhat carried away with that program and ended up using all but 15 words of memory.

My Space Trek tape includes the introductory/instruction program, followed by the game as it is presented here. I can load the instruction program for a new player, clear memory and load the game. When I'm playing, I just skip over and load the game itself. The instruction program is a nice addition and may appear in a future issue of *Kilobaud.*

Following is a full description, listing and documentation of the 4K, TRS-80 Star Trek game.

Tape Program Description

You are commanding the starship Enterprise. Your mission is to destroy 25 of the invading Klingon warships, without being destroyed yourself or running out of power and drifting in space. Your starship has the following capabilities and features.

Instruments. Give you continuous readings on power for your warp and impulse engines, phasers and shields. They also tell you how many photon torpedoes are available and how many Klingons you have destroyed. Occasionally, your onboard computer will flash a message when you've done something wrong, lost or won the game.

Sector Scanner. Visually displays the sector of space in which you are currently operating. It constantly shows the location of your Enterprise, stars, Klingon warships and any starbase that might be there.

Shields. Automatically guard you against the Klingon weapons. While you are hunting down the enemy, they will be firing at you; each direct hit reduces shield power by 4 percent. If shield power is lost, your starship will be instantly destroyed! Every live Klingon warship in your sector scores a hit on your shields during each playing cycle.

Phasers. Your standard weapons. They may be fired in all directions—up, down, right or left. Their range is limited to five units of distance. Each phaser shot costs 4 percent of phaser power for each unit of distance fired. They will destroy a Klingon warship anywhere within range.

Photon Torpedoes. Extremely powerful weapons, capable of firing at any range within your current space sector, without using any power from any of the ship's systems. They can be fired only up or down. A photon torpedo will destroy anything in its path, so use it carefully. (Note: If you shoot a star with your phasers, it will disappear from your sector scanner, but it does not leave the area. Firing beyond the range of the sector scanner can disrupt your computer's program, or it may only cause the video display to scroll up. Should this happen, enter "0,0,0" to redraw the display.)

Impulse Engine. Moves you within the current space sector. Each unit of distance moved costs 6 percent of impulse power.

Warp Engine. Used only to go from one space sector to another. The warp engine is used when you have killed all Klingons in one sector, or when fire from a Klingon-infested sector is destroying your shields, or when you must find a sector with a starbase for refueling. Each warp engine firing costs 20 percent of warp power.

Starbase. Found in just about every other space sector. Docking with a base *from the right or left side* will refuel all of your systems.

Stars. Affect the game only by restricting your movements.

Black Hole in Space. Will occasionally appear on your scanner. You cannot move through it, or fire through it. If you fire on a black hole with your phasers, it will do one of

Program listing.

```
10   F=1
100  E=0:T=1:P=2:I=3:W=4:U=1:D=2:R=3:L=4:C=0:S=0:A(66)=100
120  CLS:P.A.21,"---SECTOR SCANNER---"
130  P.A.64,"% IMP. PWR."
140  P."% WARP PWR."
150  P."% PHASERS"
160  P."  TORPEDOS"
170  P.A.112,"SHIELD PWR. %";
180  P.A.240,"ENEMY KILLED";
190  P.A.644,"INSTR. CODES: T=TORPEDO, P=PHASER, I=IMPULSE, W=WARP"
200  P.A.710"DIRECTIONS: U,D,R,L ENTER <INST.,DIR.,DIST.>"
220  IF F=0T.360
290  V=0:F.J=1TO64:A(J)=0:N.J
300  F.J=1TO3+RND(9)
310  Z=RND(64):IF(A(Z)>0)+(Z=63)T.310
320  B=RND(2):A(Z)=3:IFB=2T.330
325  A(Z)=2:V=V+1
```

```
330  N.J
332  J = RND(3):IF J<>3T.340
334  B = Q:Q = 1 + RND(62):GOS.5000:J = Q:Q = B:IF(X = 41) + (X = 83)T.334
336  A(J) = 0 - RND(3)
340  Q = RND(32):IFA(Q)>0T.340
350  GOS.600:A(Q) = 1
355  J = RND(3):IF J<>1T.360
357  A(63) = 4
360  J = Q:F.Q = 1TO64:GOS.5000:S.(X,Y):IFA(Q) = 1P.A.A,"E";
370  IFA(Q) = 2P.A.A,"K";
380  IFA(Q) = 3P.A.A,"*";
385  IFA(Q) = 4P.A.A,"B";
387  IFA(Q)<0P.A.A," ";
390  N.Q:Q = J
490  IF(E = 4) + (F = 0)T.690
500  A(65) = 98:A(66) = 100:A(67) = 98:K = 3:C = 100
510  G.695
600  GOS.5000
610  M = X:N = Y:O = A:RET.
615  P.A.560,"COLLISION !!";
620  F.B = 1TO2500:N.B :RET.
650  P.A.343," SHIP EXPLODING";:GOS.620:G.10
660  P.A.346," YOU WON!";:GOS.620:G.10
690  IF(A(Q + 1) = 4) + (A(Q - 1) = 4)T.500
695  X = M:Y = N:A = O
700  P.A.75,A(65);:P.A.139,A(66);:P.A.203,A(67);:P.A.267,K;
710  P.A.179,C;:P.A.307,S;:IFS = 25T.660
711  IF C< = 0T.650
720  P.A.915,"";:IN."INSTRUCTIONS ( I,D,D ) ";E,F,G
721  P.A.915,"":IF(F = 0) + (G = 0)T.120
722  IF(E = 1)*(F>2)T.690
725  IFE<>4T.C = C - 4*V
730  ONEG.780,760,740,800
740  IFA(65)<G*6T.690
750  A(65) = A(65) - 6*G:ONFG.1110,1210,1310,1410
760  IFG>5T.G = 5
765  IFA(67)<G*4T.690
770  A(67) = A(67) - 4*G:ONFG.2050,2150,2250,2350
780  IFK = 0T.690
790  K = K - 1:ONFG.2700,3150
800  IFA(66) = 0T.690
810  A(66) = A(66) - 20:G.290
1110 F.J = Q - 8TOQ - 8*GS. - 8:GOS.1500:N.J:G.690
1210 F.J = Q + 8TOQ + 8*GS.8:GOS.1500:N.J:G.690
1310 F.J = Q + 1TOQ + G:GOS.1500:N.J:G.690
1410 F.J = Q - 1TOQ - GS. - 1:GOS.1500:N.J:G.690
1500 IFA(J) = 0T.1520
1510 GOS.615:P.A.560,"":J = J - 1:G.690
1520 B = Q:Q = J:GOS.5000:P.A.A,"E";:S.(M,N):Q = B:GOS.610
1530 A(Q) = 0:Q = J:A(Q) = 1:RET.
2050 F.B = Q - 8TOQ - 8*GS. - 8:IFA(B) = 0T.2055
2052 G = (Q - B)/8:G.2100
2055 N.B
2100 N = Y:F.J = Y - 3TOY - 3*GS. - 1:S.(X,J):N.J
2110 Z = Q - G*8:F = Y - 3:G = Y - 3*G:H = - 1:G.2500
2150 F.B = Q + 8TOQ + 8*GS.8:IFA(B) = 0T.2155
2152 G = (B - Q)/8:G.2200
2155 N.B
2200 N = Y:F.J = Y + 3TOY + 3*G:S.(X,J):N.J
2210 Z = Q + G*8:F = Y + 3:G = Y + 3*G:H = 1:G.2500
2250 F.B = Q + 1TOQ + G:IFA(B) = 0T.2255
2252 G = B - Q:G.2300
2252 N.B
2300 M = X:F.J = X + 3TOX + 6*G:S.(J,Y):N.J
2310 Z = Q + G:F = X + 3:G = X + 6*G:H = 1:G.2600
2350 F.B = Q - 1TOQ - GS. - 1:IFA(B) = 0T.2355
2352 G = Q - B:G.2400
2355 N.B
2400 M = X:F.J = X - 4TOX - 6*GS. - 1:S.(J,Y):N.J
2410 Z = Q - G:F = X - 4:G = X - 6*G:H = - 1:G.2600
2500 E = Z
2502 IFA(Z)<>2T.2560
2510 A(Z) = 0:V = V - 1:S = S + 1
2560 J = 2:F.Z = FTOGS.H:J = J + 1:IFJ = 3T.2580
2570 R.(X,Z):G.2590
2580 J = 0
2590 N.Z:G.2693
2600 E = Z
2605 IFA(Z)<>2T.2660
2610 A(Z) = 0:V = V - 1:S = S + 1
2660 J = 2:IFF = M - 4T.J = 3
2665 F.Z = FTOGS.H:J = J + 1:IFJ = 6T.2680
2670 R.(Z,Y):G.2690
2680 J = 0
2690 N.Z
2693 IFA(E)<0GOS.4000
2695 X = M:G.690
2700 F.B = Q - 8TOQ - 8*GS. - 8:IFA(B) = 0T.2720
2710 G = (Q - B)/8:G.3100
2720 N.B
3100 N = Y:F.J = Y - 3TOY - 3*GS. - 1:R.(X - 1,J + 1):S.(X - 1,J):N.J
3110 J = J + 1:Z = Q - (G*8):GOS.3500
3120 G.3220
3150 F.B = Q + 8TOQ + 8*GS.8:IFA(B) = 0T.3160
3155 G = (B - Q)/8:G.3200
3160 N.B
3200 N = Y:F.J = Y + 3TOY + 3*G:R.(X - 1,J - 1):S.(X - 1,J):N.J
3210 J = J - 1:Z = Q + (G*8):GOS.3500
3220 Y = N:G.690
3500 R.(X - 1,J):S.(X,J)
3510 IFA(Z)<>2T.3540
3520 V = V - 1:S = S + 1
3540 A(Z) = 0:RET
4000 Z = E:IFA(Z) = - 1T.650
4010 B = Q:Q = Z:GOS.5000:IFA(Z) = - 2T.4040
4030 P.A.A,"B";:Q = B:A(Z) = 4:RET.
4040 P.A.A.,"*";:Q  = B:A(Z) = 3:RET.
5000 Y = 4 + 3*INT(Q/8.1)
5001 X = 35 + 6*(Q - (8*(Y - 4)/3))
5002 A = 84 + ((Y - 4)/3)*64 + ((X - 41)/6)*3
5003 RET.
```

the following: (1) Turn into a harmless star. (2) Turn into a starbase where you can refuel. (3) Instantly cause your ship to explode!

Commands. Instructions are: TORPEDO, PHASER, IMPULSE and WARP. Directions are: Up, Down, Right or Left. Distance moved equals the number of spaces entered. Type in the first initial of your desired instruction, the first initial of the direction you want to move and the distance. Always separate each with commas. For example, to fire phasers three spaces to the right, enter "P,R,3."

General Information

No title display or instructions are included in the Space Trek game program because all available memory was committed to features and video display information. No safeguards are built in to prevent entry of command letters and numbers outside the allowed range, or to keep you from firing beyond the range of the scanner.

If a legal command produces no action, check the power level of that system. Moves that would require more than available system power are not allowed. If you find yourself stranded in space (i.e., game not completed, but no power to move), you have lost by default. Press BREAK and type in "RUN" to start a new game.

This version of Space Trek was written for use on the Radio Shack TRS-80 microcomputer with Level I BASIC and 4K RAM. There are no known problems with the program other than those discussed above which might be caused by illegal operator-entered commands and instructions. ■

ARRAY:

A(1) – A(64) MEMORY MAP OF SECTOR SCANNER PLAYING FIELD

0 = BLANK SPACE	−1 = EXPLOSION (BLACK HOLE)
1 = ENTERPRISE	−2 = STAR (BLACK HOLE)
2 = KLINGON	−3 = STARBASE (BLACK HOLE)
3 = STAR	
4 = STARBASE	

A(65)	IMPULSE POWER REMAINING
A(66)	WARP POWER REMAINING
A(67)	PHASER POWER REMAINING

MEMORY MAP: CURRENT SECTOR LOCATIONS ARE CONTAINED IN THE A(1) THROUGH A(64) ARRAY IN THIS ORDER:

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

A	SCANNER ("PRINT AT" LOCATION)
B	DELAY LOOP COUNTER (ALSO USED IN OTHER LOOPS)
C	SHIELDS POWER % READING
D	=2 'DOWN' INSTRUCTION CODE
E	INSTR. CODE INPUT VARIABLE (ALSO USED IN OTHER LOOPS)
F	DIRECTION CODE INPUT VARIABLE (FOR . . NEXT VARIABLE, 2000 SUBROUTINE)
G	DISTANCE CODE INPUT VARIABLE (FOR . . NEXT VARIABLE, 2000 SUBROUTINE)
H	FOR . . NEXT LOOP STEP VARIABLE, 2000 SUBROUTINE
I	=3 'IMPULSE' INSTRUCTION CODE
J	LOOP COUNTER
K	NUMBER OF AVAILABLE PHOTON TORPEDOES
L	=4 'LEFT' DIRECTION CODE
M	PREVIOUS X-COORDINATE
N	PREVIOUS Y-COORDINATE
O	PREVIOUS POSITION ("PRINT AT")
P	=2 'PHASER' INSTRUCTION CODE
Q	ENTERPRISE'S POSITION IN MEMORY MAP ARRAY
R	=3 'RIGHT' DIRECTION CODE
S	NUMBER OF DEAD KLINGONS
T	=1 'TORPEDO' INSTRUCTION CODE
U	=1 'UP' DIRECTION CODE
V	NUMBER OF LIVE KLINGONS IN PRESENT SECTOR
W	=4 'WARP DRIVE' INSTRUCTION CODE
X	X-COORDINATE
Y	Y-COORDINATE
Z	LOOP COUNTER

Table 2. Variables used.

KB CALENDAR

Chicago IL

The 10th Anniversary Professional Training Conference, sponsored by Advanced Systems, Inc., will convene at Chicago's Hyatt Regency O'Hare Hotel, Monday and Tuesday, October 30-31. Registration begins Sunday evening, October 29. ASI, 1601 Tonne Rd., Elk Grove Village IL 60007.

Cambridge MA

Papers are invited for presentation at Specifications of Reliable Software, a conference sponsored by the IEEE Computer Society's Technical Committee on Software Engineering, April 3-5, 1979, Cambridge MA. A suggested list of topics to be covered includes the theory of, and experiences with, formal specification languages; disciplined specification methods; verification of the consistency and completeness of specifications; quality, adequacy and usefulness of specifications; and future research directions. Deadline for submitting papers is November 1, 1978. Send four copies to Marvin Zelkowitz, Department of Computer Science, University of Maryland, College Park MD 20742, (301) 454-4251.

Bluefield WV

Thursday, October 5, 1978, Bluefield State College will sponsor southern West Virginia's first seminar and exhibition of the business and engineering application of mini/microcomputers. There is a $15 fee for both seminar participants and exhibitors. Persons interested in participating or exhibiting, contact Dr. Alvin Hall, Director of Continuing Education, Bluefield State College, Bluefield WV 24701, (304) 325-7102.

Madison WI

A call for papers has been issued for the 1979 International Symposium on Fault-Tolerant Computing, to be held in Madison WI, June 20-22, 1979. Papers are solicited on any subject in the general area of fault-tolerant computing. Four copies of an abstract (200 words maximum) should be sent to the Program Chairman: Gerald M. Masson, Dept. of Electrical Engineering, The Johns Hopkins University, Baltimore MD 21218, to be received no later than November 1, 1978. Four copies of a complete paper of maximum length of 4000 words should be sent to the Program Chairman to be received no later than December 1, 1978.

Ft. Lauderdale FL

A workshop on Software Testing and Test Documentation will be held at the Bahia Mar Hotel, Ft. Lauderdale FL on Dec. 18-20, 1978. Participants will be invited on the basis of a 1000-3000 word abstract. The abstract should indicate whether the work is currently active or proposed for the future. For further information write to: Dr. Edward F. Miller, Jr., Software Research Associates, PO Box 2432, San Francisco CA 94126.

Dallas TX

International Microcomputer Exposition, Dallas—Sept. 29-30-Oct. 1, 1978. Dallas Convention Center, 413 Carillon Tower, 3601 Preston Rd., Dallas TX 75240, (214) 271-9311.

Boston MA

The Boston Computer Society presents "Home/Business Computers '78 . . . An exposition of the state of the art in microcomputers," at Sherman Union, Boston University, 775 Commonwealth Ave., 10 AM to 5 PM on October 7, 1978. For more information call 884-7291 or write: The Boston Computer Society, 17 Chestnut Street, Boston MA 02108.

J. Tom Badgett
1917 Washington St.
Bluefield WV 24701

Will DEC and IBM Be the Final Winners?

Kilobaud asked Tom to visit ComputerCo to do this story. They seem to have some interesting and worthwhile approaches to the game of developing small-business hardware and software. See if you agree.

When we think of American business, we generally think of the large corporations—big companies with big names and large payrolls. The fact is, the largest employer in the United States is small business, firms without national connections, usually with few employees. More than ten million businesses in this country—roughly 85 percent of all business—qualify as "small" businesses under Small Business Administration (SBA) guidelines. They have fewer than 500 employees and gross sales under three million dollars. Many—if not most—of these, of course, are much, much smaller.

The Internal Revenue Service estimates that around 4700 small businesses are spawned in this country each week, while 4500 others fail. At least 80 percent of the failures are caused by poor management.

"The largest problem is record keeping—accounting procedures and things like that," says Ken Jennings, SBA management assistant. "The successful businesses don't have that problem," he continues, "but the unsuccessful ones, the businesses that are teetering on the edge, just won't make it because of poor record keeping." Jennings maintains that the successful businessman knows "to the penny" what it costs him to open the doors each morning and how many sales he'll have to make that day just to break even.

"We try to impress each client with the idea that he needs a good lawyer, a good banker and a good accountant," says Dean Kenny, director of SBA's Center for Economic Action in Athens WV. "That's the basic team; they're like members of his board of directors; they're his consultants."

ComputerCo is the "business" end of the Charleston SC operation. World of Computers is the firm's hobby outlet next door, but the hobby market hasn't really arrived. "We have a Compucolor and some Poly 88s, but we mostly use them to take the strain off after hours—something for the ComputerCo staff to play with," says World of Computers Manager Joe Sinkovich.

Help for Businessmen

One of the first steps Kenny takes to help a troubled businessman back onto his feet is to enroll him in a special workshop on record keeping. "One of the most important things we can teach any small businessman is to work up a monthly profit/loss statement—sales versus expenses," Kenny says.

Talk to even a successful businessman and he'll tell you that's not always easy, however. Especially for the very small business where the owner also is the production manager, office manager and bookkeeper, paperwork sometimes can become stifling.

Enter the small computer. It isn't hard to understand why so many small businessmen responded enthusiastically, even aggressively, when they discovered that new processor technology had produced powerful computers with very attractive prices. It's easy, too, to understand their disappointment and frustration when they learned that while these new microprocessors could serve business needs, it sometimes took an engineer and programmer to make them work. More and more business software is being written for the so-called "hobby" computers, but some professionals contend that

problems still abound.

"A lot of advertising is misleading, and many of these companies don't offer support for their systems," charges Doug Boseman, president of ComputerCo, Inc., located at 5833 Dorchester Road in Charleston Heights SC. "The software is not written using accounting concepts, nor will it operate as suggested without major design changes. The prices are low, but a lot of businessmen are getting burned by these offerings," he continues.

Boseman's company is marketing a business-oriented hardware/software package he claims is the first truly functional system for the small businessman. The "big boys" —IBM, Wang, Burroughs, TI, HP—aren't serving the small businessman with their $30,000-plus systems, he says, but they're trying to ride their "better name" to reach this growing market.

"Our thrust is to reach the company who couldn't afford a computer before," he says. "Our system doesn't require a computer operator—a programmer—that's what makes it better."

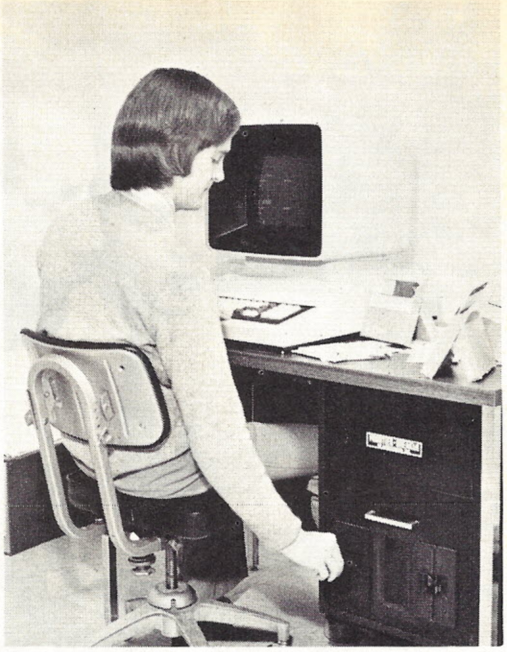
ComputerCo prospects gross less than five million dollars, and the owner or other official can personally negotiate an equipment purchase. "If your transactions are running to the point that you need another employee to get the management and financial information you need, you can afford a computer," Boseman says.

The average price of the ComputerCo Frontier-Breaker system with personalized software is about $9000. That includes an 8080A-based CPU, 48K of 350 ns RAM, twin mini-floppies, video terminal and a 132-column printer.

Many so-called small systems can be purchased for around $15,000, but software development for individual companies costs extra. That cost sometimes can run two or three times hardware expenses.

Software, on the other hand, frequently is the tool that sells

This is one approach to small business computing: The DEC 11/34. But for some specialty applications—such as this coal company's—your $46,000 doesn't buy much more computing power than you could get with a good quality $10,000 "hobby" system. It takes a part-time operator and full-time programmer to fully utilize this system.



Programmer Rod Anderson with the Frontier-Breaker system. The Okidata 22 printer is sitting to the right of the desk in this picture. The CPU, memory and power supply are behind the sign on the top drawer. A new "designer" desk soon will replace the one shown here.

some businesses on the $50,000-$100,000 systems. Unfortunately, even at that price, the machine may require a full-time programmer to write specialty programs.

I visited the operator of one such system at a major West Virginia coal company recently. His company bought a DEC 11/34 two years ago. The hardware included the processor, "around 36K" of memory, two disk packs, two printers and a video terminal. The price tag was $46,000 and he's still developing software to handle the specialty needs of the coal business.

Even a "hobby" system could maintain the kind of records this coal company needs, since they were willing to hire a full-time programmer to develop the software anyway. What Boseman has done is assemble a streamlined computer system that falls somewhere between a high-priced hobby unit and the startlingly expensive business systems.

"But the only trade-off between our system and one costing two or three times as much is time, speed," Boseman asserts. "It would probably take a businessman or accountant half an hour longer to run his average CPA client write-up on our machine as opposed to the IBM System 32. What's 30 minutes? It probably takes him five days by hand."

Genius of a System

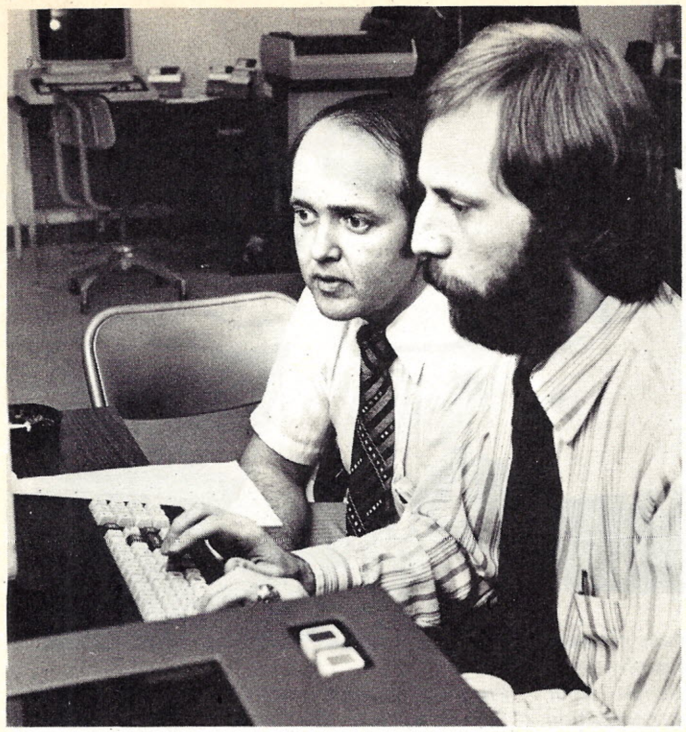
Doug hired his brother Dusty to start working on a small-business system early in 1976. Doug studied engineering at Clemson, was introduced to computers strapped in the back seat of F-4s in Vietnam and holds an accounting degree. After his stint with the U.S. Marines, he opened his own accounting office and quickly became involved with writing accounting programs.

"We programmed the NCR, Wang, had some IBM contracts and found that nobody out there had a workable, usable system for a small businessman," he says.

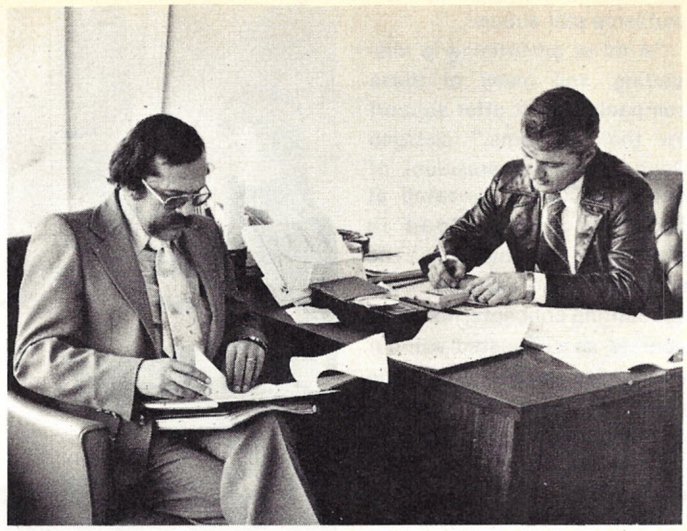
Dusty also is an accountant who is heavily into programming. Before starting at ComputerCo he installed, as an end user, five mini systems to handle accounting for oil companies, motels and municipalities. "Most computers are designed by systems analysts who have very little—or no—knowledge of accounting," he laments. "Many people selling systems today think that hardware should get the major emphasis, but software is the important thing."

So Doug set about designing a system with criteria he felt was lacking in the big company offerings: a compact unit fully upward expandable, a video terminal and a quality printer that didn't make a lot of noise. He wanted a system someone already in the office could operate. His dream design had to include hardware with long-term reliability and that could be purchased in large enough quantities to meet customer demands. The software had to be specialized to meet needs of individual companies and to make the transition to computer as painless as possible. The price had to be low enough to appeal to the small businessman, and he wanted within the company the expertise and integrity to give full customer backup over the long haul. "We've satisfied all those requirements," Doug boasts.

The compact size is fairly evi-



Bryant "Dusty" Boseman, left, works out a programming kink with Ray Miller, one of the firm's full-time programmers. Dusty constantly is moving from console to console, answering questions and making suggestions as programs are written.



World of Computers General Manager Joe Sinkovich, left, in a "skull" session with ComputerCo President Doug Boseman.

dent from the accompanying photographs. The CPU, memory, power supplies and twin disk drives all are housed in a small two-drawer desk. The video terminal sits atop the desk, and the printer generally has a stand of its own beside the desk.

The result is a self-contained unit that takes little more room than a standard office desk and typewriter stand. Wiring between units is simple, and the effect is uncluttered—almost plain. When this article was written (February 1978), plans were under way for a new, modernistic enclosure for the system.

The Fox video terminal provides quiet operation (the folks at ComputerCo seem to have a "thing" about noisy computer installations). Though it is relatively large, it does offer a full-sized keyboard with separate numbers keypad and "electric typewriter" action. The 12-inch display has the usual "bells and whistles" of a commercial video terminal.

The printer is an Okidata 22 and is capable of 60, full, 132-character lines per minute. It features bidirectional printing, uppercase and lowercase and excellent legibility for a matrix printer. Other printers are being considered, especially for customers who choose the company's new word-processing software and need better quality than dot matrix can provide.

The disk drives are North Star minis with Orbis 630K disks offered as an extra cost option for businesses with large storage needs. Soon the company will be moving to the 12 megabyte Calcomp hard disks.

In building the Frontier-Breaker, ComputerCo engineers start with a standard PolyMorphic 88 microprocessor card and modify it for more efficient business system operation. They do away with the vectored interrupts and real-time clock, for one thing, and they've designed their own PROM monitor. The S-100 40K memory card also is provided by PolyMorphic. Production engineer Jim Thorp designed the power supply.

Dusty Boseman is somewhat uncomfortable talking about a CPU most people perceive as a hobby unit being installed in a business system, but he quickly interjects: "The design changes Jim and his staff have made have taken it away from the hobby idea altogether. It definitely is not a hobby system."

They emphasize that both hardware and software can be expanded with minimum effort,

ISSUE DATE : 01-30-78 ACCOUNTS RECEIVABLE PAGE : 1
DATA DATE : 12-15-77 AGE ANALYSIS

ACCOUNT	CUSTOMER NAME	TELEPHONE #	CURRENT	OVER 30	OVER 60	OVER 90	OVER 120	CURPAYDAT	MTDPAYMENT
2036	ROD ANDERSON	(803) 566-8322	170.00	1100.00	1200.00	1300.00	1130.00	12-10-77	-270.00
2117	W. BAILEY WATSON	(803) 571-3305	1135.00	100.00	200.00	300.00	325.00	12-04-77	-75.00
2191	MITZI A. WATSON	(803) 571-3307	50.00	500.00	1000.00	1500.00	2000.00		.00
2214	CAROLE P. WATSON	(803) 571-3306	80.00	.00	.00	.00	.00		.00
2222	CAROL L. KINNEY	(803) 566-2931	250.00	425.00	525.00	625.00	750.00		-75.00
3121	RAY MILLER	(803) 552-6700	220.23	275.00	375.00	475.00	575.00		.00
# CUSTOMERS LISTED= 6		GRAND TOTALS :	1905.23	2400.00	3300.00	4200.00	4780.00		-420.00

Sample 1. One of the goals of the company was to make the change from hand-entry bookkeeping to computer easy. This age analysis listing shows the left-to-right format used in most accounting programs (names are not actual accounts . . . used for illustration only).

Linda Greene, right, and Nancy Nester run through a CPA business program. "We're sure of this one," she beams, "it really works." Linda operated large business computers before joining ComputerCo. Though the small computer runs slower than the big machines, she says a given computing job may actually go faster on the ComputerCo equipment because the operating procedures are less complicated.

"I suppose I abuse my time by running the computer myself, but it really is fun," says Pyramid Builders President James Ilardi, who helped develop ComputerCo's contractor software. He has cut job analysis and inventory from three weeks to 24 hours with his computer. "All our suppliers use computers and they can follow inflation, change prices. If you don't respond in kind you're going to be out in the cold," he says.

without outdating any of the basic unit. And, they say, the hardware is kept as unobtrusive as possible so office personnel with no experience in data processing will feel comfortable making the change. "It would be ideal if the customer didn't even realize he had any hardware," chuckles Thorp.

The ComputerCo Approach

ComputerCo took what is apparently a unique approach to software development. They hired four young college graduates off the street, none with computer or programming experience! "They had zero experience, no schooling in computers, no hands-on experience," Dusty says. "They're just bright, intelligent people."

Though Dusty's title with the company is sales engineer, he supervised the software development. The first major accomplishment was a 20K written-in-BASIC Data Base Management System (DBMS), the utility software that actually drives the system. It had many capabilities, but was too slow for expanding business needs, so it has been rewritten in machine language and BASIC for speed.

Since accounting is the major small-business problem area, ComputerCo started with an accounting package. The basic Certified Public Accounting software was designed to follow the standard information flow usually requested of a small businessman. It'll maintain a general journal, general ledger, payroll register, financial statements and prepare IRS forms 941 and W-2.

Many of these same accounting features are contained in the construction package, but the contractor's software includes job cost estimating. An automobile dealer's package adds inventory control with cost analysis. Software options for any basic package include inventory, educational (computer-aided instruction), administration (scheduling, etc.),

WORD PROCESSING

LETTER DESCRIPTION LISTING

02-01-78 COMPUTERCO, INC. PAGE 1

	LETTER #	DESCRIPTION		LETTER #	DESCRIPTION		LETTER #	DESCRIPTION		LETTER #	DESCRIPTION
*	1	CADILLAC	*	2	SPITZ	*	3	DATSUN 280-Z	*	4	JUDGESHIP
*	5	CONDOMINIUMS	*	6	EXTEND CREDIT	*	7	COMPUTERS	*	8	
*	9	CAMARO RALLY	*	10	XMAS CARDS	*	11	HEARING	*	12	PHOTOGRAPHY
*	13	EASTER CARDS	*	14		*	15		*	16	
*	17		*	18		*	19		*	20	
*	21		*	22		*	23		*	24	
*	25		*	26		*	27		*	28	
*	29		*	30		*	31		*	32	

Sample 2. This printout shows the operator which letters currently are stored. Any of these may be called up for printing with a separate "label" or address program, or they may be modified or deleted as needed.

engineering and survey, word processing and labels.

Most ComputerCo software can be purchased as an integrated package or in smaller pieces. "This way the customer doesn't have to pay for features he doesn't need," Dusty says. "He can always add the other features later." But how do you ensure your software features will be meaningful to the end user?

"We've taken the analyst and the engineer out of the end concept and put the businessman in," Doug says. Both Doug and Dusty have a pretty solid accounting background, but when it came to designing software for such industries as construction, they went to the end users and asked them what the system needed. They'd write the program, let contractors use it for a time, then rework it for refinement.

"I was all set to buy a Wang PCS-2 but I couldn't get the software I needed," says Jim Ilardi, a Charleston contractor who helped develop the ComputerCo software and now uses the system in his business.

"He uses his machines heavier than we use ours for program development," Dusty marvels.

Before switching to computer, Ilardi found that keeping track of job costs and inventory was a difficult job. Frequently it took him three weeks to get such information together, and then the data were three weeks old—virtually useless. The computer has made a difference.

"We have a staff of five people working on five jobs with perhaps a five-million-dollar volume," Ilardi says. "Now that I'm getting 24-hour cost and inventory figures I think we can increase our volume four times without an increase in personnel. It ought to save us a considerable amount of money."

Ilardi is one of those instant computer converts. He's already thinking about the time when a small unit can be installed at each job site and handle payroll, inventory and job cost duties. Ilardi figures he probably abuses his time by operating the machine himself ("I enjoy working with it. It is such a pleasure to get the figures out.") and warns other businessmen that the transition from conventional bookkeeping to computer-assisted accounting can be a difficult process.

"It's not as easy as you'd like to think," he says, "but it is worth any pains you have to go through. I don't know that any small businessman can afford to be without access to one."

Dick Bissel runs an employment agency. His branch offices may submit as many as 1000 applications a day for central office processing. He has just completed a switch to

ISSUE DATE : 01-30-78 CASH RECEIPTS PAGE : 1
DATA DATE : 01-30-78 SALES JOURNAL JOURNAL# : 100001

LINE#	REFER#	*DATE*	ACTNUM	COMMENT***	COD	INV$-AMT*	SALES-TAX	AMOUNT-PD	DISC$-AMT
1	10001	120277	2214	INVOICE	95	150.00	5.77	100.00	2.00
2	10002	120277	2036	PAYMENT	0			40.00	3.50
3	10003	120377	2191	ENDPERIOD	99				
4	10004	120377	2222	ADJUSTMENT	98	-75.00	-2.88		
5	10005	120477	2117	PAYMENT	0			75.00	4.60
6	10006	120677	2117	INVOICE	51	1147.00	44.12	82.00	50.00
7	VOIDED								
8	10008	121077	3121	INVOICE	94	345.23	13.28	300.00	
9	10009	121077	2222	ADJUSTMENT	98			-25.00	-5.00
10	10010	121077	2036	PAYMENT	0			230.00	4.00
11	10011	121177	2214	INVOICE	96	217.57	8.37	217.57	10.00
12	10012	121277	2214	INVOICE	93	98.00	3.78	98.00	
13	10013	121277	2222	INVOICE	87	34.50	1.33	34.50	2.00
14	10014	121377	2222	INVOICE	45	585.15	22.51	400.00	
15	10015	121377	3121	ADJUSTMENT	98	-54.00	-2.08		
16	10016	121477	2117	PAYMENT	0			34.23	4.23
				GRAND TOTALS:		2448.45	94.20	1586.30	75.33

ISSUE DATE : 01-30-78 CASH RECEIPTS PAGE : 2
DATA DATE : 01-30-78 SALES JOURNAL JOURNAL# : 100001

	COD	INV$-AMT*	SALES-TAX	AMOUNT-PD	DISC$-AMT
	0			379.23	16.33
	45	585.15	22.51	400.00	
	51	1147.00	44.12	82.00	50.00
	87	34.50	1.33	34.50	2.00
	93	98.00	3.78	98.00	
	94	345.23	13.28	300.00	
	95	150.00	5.77	100.00	2.00
	96	217.57	8.37	217.57	10.00
	98	-129.00	-4.96	-25.00	-5.00
GRAND TOTALS:		2448.45	94.20	1586.30	75.33

ACCT#	DESCRIPTION******	DEBIT****	CREDIT***
10005	CASH IN BANK	1510.97	
10403	ACCOUNTS RECEIV.	862.15	
59902	MISCELLANEOUS	75.33	
21404	SALES TAX PAYABLE		94.20
40107	INCOME		2354.25

PROOF TOTALS: .00

Sample 3. An example of the general journal printout. The listings under COD are code numbers to help the computer identify the type of transaction. Notice the listing "Proof Totals: .00" at the bottom of the listing. This is the output of a check program within the general journal to make sure everything is in balance.

microfilm to reduce filing and mailing costs; now Bissel wants a computer to save even more time in getting employers and job applicants together. He claims to have spent $100,000 over the past three years investigating perhaps 50 computer systems, but none would satisfy his special software needs and provide fast, local service. He finally decided on the ComputerCo system because they were willing to help him develop software.

"I expect the computer to increase our efficiency at least as much as the switch to microfilm, and that was a tenfold improvement," Bissel predicts.

A "Training Program"

The ideals professed by ComputerCo officials and the specifications on their software sound impressive. From the top down there is an excitement in the company about the job they're doing . . . and the future. After several hours in this atmosphere, I became the skeptical outsider.

"Suppose you've just delivered a new system to my office. Now teach me to run the accounting package," I challenged Dusty. Admittedly I have had more hands-on computer experience than the average office secretary and I've done some programming in BASIC, but I know nothing about accounting, and until my visit to ComputerCo I never had personally used a disk-based computer system.

"Do you have about 20 minutes?" Dusty grinned, and we moved to one of the three Frontier-Breaker systems in constant operation at the ComputerCo office.

Actually I spent a couple of hours running accounting and word-processing programs. During that time I did not become an expert, but indeed after perhaps half an hour the mechanics of operating the machine had become quite clear. I expect if we had used account names and billing data I was familiar with—as we would have if the system really were being installed in my office and I had been handling the bookkeeping by hand all along—my proficiency would have been much greater at the end of my two-hour session.

Structured programming, ComputerCo believes, is the key to software success. Everything is worked out on paper before the programmer enters anything into the computer. This is Carole Watson, who wrote the word-processing package.

"It takes about a week to train someone to run their own programs, and we'll work closely with a new client to help them make the changeover," Dusty promises.

I wondered whether I or some other inexperienced operator might not be able to cause the system to crash and burn, wiping out valuable business records. I was assured it takes a dedicated effort to do that. First you have to select the file to be scratched, then the computer requires you to enter "positive" before it erases anything.

"You back up the files each day anyway," Dusty adds. "It only takes a minute-and-a-half to copy a platter and your backup will never be out of the safe."

The programs are written for the inexperienced operator. There is printed documentation with each package, of course, but the programs run with heavy prompting and directions. It is difficult to make a mistake. And they've included some nice little conveniences such as automatic line numbering and incrementing of account numbers. Whenever possible the software is written to follow standard, familiar formats to make the changeover easier.

"A bookkeeper is used to posting from left to right on a

```
I-------------------------------------------------------------------------I
I ACCOUNT!STATEDATE! PG!DEBIT BALFWD!CREDITBALFWD!KEEP THIS STUB FOR  I
I   2036 ! 01-30-78!  1!     5170.00 !            !YOUR RECORDS        I
I--------!---------!---!-------------!------------!--------------------I
I REFER# !TRANSDATE! CD!  CHARGES    !  CREDITS   ! DESCRIPTION        I
I--------!---------!---!-------------!------------!--------------------I
I  10002 ! 12-03-77!  0!             !       40.00 ! PAYMENT           I
I  10003 ! 12-04-77! 99!             !             ! ENDPERIOD         I
I  10010 ! 12-10-77!  0!             !      230.00 ! PAYMENT           I
I        !         !   !             !             !                   I
I        !         !   !             !             !                   I
I        !         !   !             !             !                   I
I        !         !   !             !             !                   I
I        !         !   !             !             !                   I
I        !         !   !             !             !                   I
I        !         !   !             !             !                   I
I        !         !   !             !             !                   I
I        !         !   !             !             !                   I
I        !         !   !             !             !                   I
I-------------------------------------------------------------------------I
IS.C.RATE! S.C.  AMOUNT !  CURRENT    !OVER 30 DAYS!OVER 60 DAYS       I
I  1.50% !        73.50 !       73.50 !     170.00 !    1100.00        I
I 18.00% !      1200.00 !     2430.00 !    4900.00 !    4973.50        I
I A.P.R. !OVER 90 DAYS  !OVER120 DAYS!TOTALPASTDUE!BALANCE DUE         I
I-------------------------------------------------------------------------I

                         ( 0) 0- 0



   STATEMENT OF ACCOUNT FOR:            **DATE**         BALANCE



    ROD ANDERSON                        01-30-78      $4,973.50*
    HIGHWAY 7
    CHARLESTON, S.C. 29407
```

Sample 4. Here's an example of a month-end financial statement. This run includes posting to update disk-stored records. Another section of the program allows for mid-month checks on accounts without posting.

page," Dusty points out. "We do the same thing on the screen. We don't go to a vertical format."

The accounting programs, particularly, are heavily redundant and the computer constantly checks up on itself to make sure there are no errors.

"With our programs it is virtually impossible to have an out-of-balance condition," Dusty claims. "One CPA told us it's easy to post books but hard as hell to balance them. That's where the computer comes in. You make an entry one time and the computer does all the updating for you."

I was more interested in the word-processing package and I suppose I'm like most neophyte computer users: I expect too much from the machine. I was somewhat disappointed in the word-processing software, though admittedly it still is under development. It is set up primarily for letter writing and envelope addressing or label preparation. Editing more than a single page of text becomes cumbersome, and the editing procedures within a letter could be refined. But the computer does prompt the user, so it is hard to make a mistake.

The Frontier-Breaker has been under development since early 1976. The first units actually were delivered in October 1977, and they're promising 60-day delivery on new systems. Already ComputerCo is establishing a national dealer system that includes software and service. They feel there's adequate hardware supply backup to allow for controlled expansion, and Dusty Boseman optimistically projects annual sales of 25 to 75 million dollars within a couple of years.

Computers' Coming of Age

No one company, of course, has all the answers to the small businessman's needs. Already most microcomputer manufacturers are realizing that the real market for their machines is in the business world, not with hobbyists. And there's a lot of good hardware out there that can serve very well in the business environment.

With so many of these systems, however, software is the missing link. Unless the businessman has the time and inclination to develop his own programs, he can end up with thousands of dollars' worth of computer hardware he can't use. In recognizing this shortcoming, companies like ComputerCo are on the right track. They're helping to change the microcomputer from a novelty to a necessity.■

Little Bits

R. J. Bosen
Box 93
Magna UT 84044

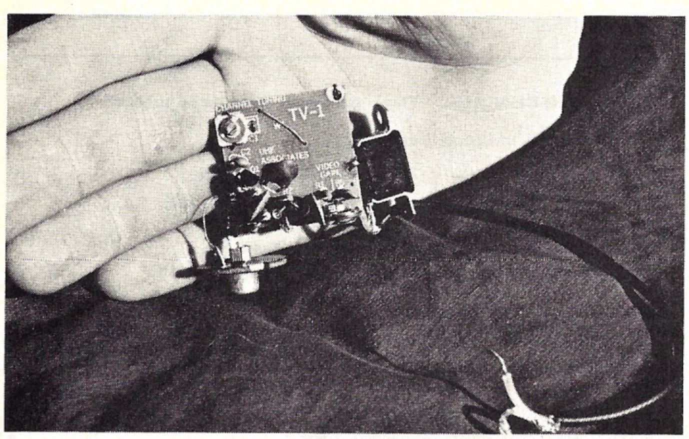
TV Modification or the TV-1?

I've read at least a dozen articles about video terminal products that require some kind of modification of a home TV set to display the composite video output they provide. I didn't worry about that too much because I knew if I could get a schematic for my portable TV I could accomplish this modification in a couple of hours at the cost of a few connectors and simple components.

Then one day, while on my weekly drool through the local computer store, I saw a tiny PC board labeled TV-1, with equally tiny advertising, that looked like it would save me that couple of hours and the handful of components; so I put ten bucks on the counter and walked out with it.

It took me about half an hour to build it, and it worked just fine the very first time. Five minutes of tuning and twiddling put me "on the air" on channel 6, and, after a few hassles fastening the board securely on the back of my TV (the picture clarity wavers if the board flops around back there), I was thoroughly satisfied with the sharpness and quality of the 64 characters my VDM packs onto each line.

If you are considering buying a schematic for your TV and kludging a composite video input into the innards, or paying the $10 or so for a TV serviceman to do this for you, I recommend investigating the TV-1. It tunes channels 2 through 6, and, having seen it in comparison with the displays available by the more conventional means, I can say it looks just as good. It provides a 75 Ohm output, but I connected it directly to the 300 Ohm antenna terminals of my TV and have had excellent results and no visible interference on the household television located just 30 feet away. ■



The TV-1. I added the connectors. *(Photo by Lisa J. Pierson)*

Marion Baggett
262 Harvard St. #11
Cambridge MA 02139

Voltage Surges

Now that you've invested several hundred (or thousand) dollars in a computer how do you protect it against voltage surges? The answer may be a Voltage Surge Protector (VSP), currently marketed (by the General Electric Wiring Devices Department in Providence RI) through electrical and hardware stores. This new device looks like an ordinary three-prong adapter, and it could save you some money.

Surges and transients can be caused by motors turning on and off, power failures, blackouts and lightning striking near your residence. This unit will not protect against a direct lightning strike—for that you'd need a professionally installed lightning arrester system—but for about $10 it's a bargain.

You could protect your system by unplugging it every time you finish using it, but you might not always remember to do so. Also, if the unit is switched off and not unplugged, voltage transients can still cause damage!

The VSP has the ability to protect equipment from a voltage surge of several thousand volts. The excessive voltage is attenuated down to 600 volts or less (see Fig. 1). The secret to the device's operation is the GE metal oxide varistor, which acts as a safety valve to absorb transients without interfering with usual current flow or increasing the energy cost. Conventional selenium and silicon suppressors dissipate power. ■

Voltage Spike Protector. (Picture courtesy of General Electric)

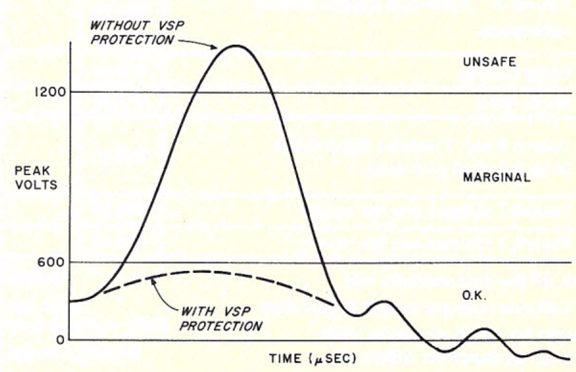


Fig. 1. Voltage spikes last about .1 to 1 millisecond. This is a typical waveform with and without a VSP.
(Graph courtesy of General Electric)

Jack Starr
8221 Halprin Dr.
Norfolk VA 23518

Want to Buy a Little Insurance?

Microcomputers don't have much tolerance when it comes to supply voltages (Vcc). We may stumble around for hours with misapplied software, but one little high voltage spike may produce a big "Phsst!"

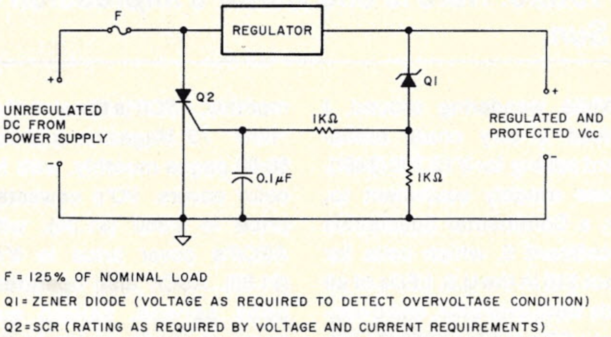


Fig. 1.

Don't despair—just beware. A little insurance against overvoltage is available for minimum cost in the form of a crowbar circuit similar to the one shown in Fig. 1. It will detect any overvoltage situation and immediately shut down your computer before it fries a lot of expensive chips.

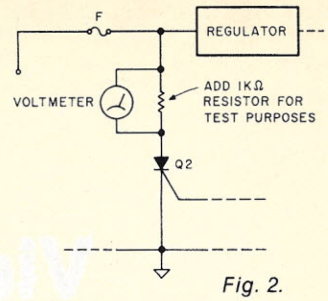


Fig. 2.

Operation is simple and construction straightforward. When Vcc reaches the voltage determined by the zener diode Q1, the SCR, Q2, triggers and conducts heavily, blowing the fuse. The circuit won't load down your regulator if the SCR triggers because of some transient condition. Most important, however, the fuse blow is immediate due to the short circuit. This "fast blow" feature is important because the time required to blow a fuse is a function of the applied current.

To check the reliability of the crowbar circuit place a 1000 Ohm, 2 Watt resistor in series with the anode of the SCR as shown in Fig. 2. Place a voltmeter parallel to the resistor. Then apply voltage to see if the SCR fires at the desired Vcc. As the SCR fires, a sudden voltage surge will appear on the voltmeter across the resistor.

If necessary, change Q1 or add diodes in series with it to obtain the desired trip voltage (germanium diodes = 0.3 V; silicon diodes = 0.6 V). When all adjustments are OK, remove the 1000 Ohm resistor from the circuit. You just bought an insurance policy! ■

Ralph Tenny
PAVCO Electronics, Inc.
12810 Coit Rd.
Dallas TX 75251

Gate Delays: Not To Be Overlooked!

A casual examination of the electrical characteristics for CMOS devices seems to indicate that many such devices are suitable for use with microprocessors, if the microprocessor clock rate is 2 MHz or less. However, careful examination of bus timing on several processors will reveal insufficient time margins during "write" operations, regardless of the CPU clock rate.

Fig. 1 shows the critical parameters that need to be checked: (1) Write strobe width (T_W) must exceed the minimum strobe width required by the CMOS part; (2) data hold time (T_h) must meet CMOS specifications; (3) data setup time (T_S) is usually not a problem, but remember to compute setup time with regard to the rising or falling edge of the strobe, depending upon which edge loads the CMOS part.

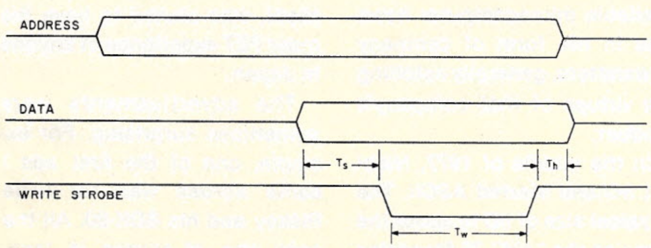


Fig. 1.

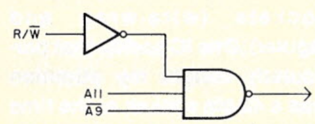


Fig. 2.

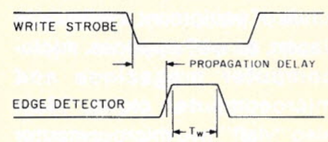


Fig. 4.

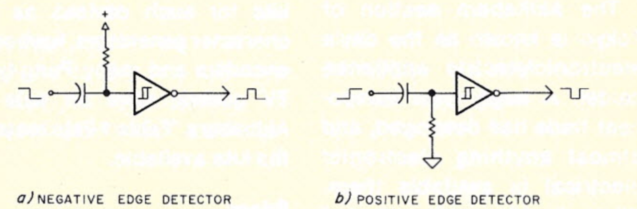


Fig. 3.

If a special strobe is created using combinatorial logic (Fig. 2), remember that propagation delay through the gates will reduce or eliminate any timing margins that did exist. For this reason, such strobes nearly always must be generated with low-power Schottky devices due to the long delays associated with CMOS parts.

A Schmitt-trigger edge detector (Fig. 3) often will solve the problem, even if a CMOS device is used. Examine the bus waveforms to find a suitable edge and choose an RC time constant that produces a pulse 25 percent wider than the CMOS needs. Fig. 4 shows the effect; the combined propagation delay and pulse width will rarely be as long as the Write strobe, yet all data setup and hold times will be met. Due to the high input impedance of CMOS (74C14, MC4584B, CD40106B), the RC time constant can be computed directly. If low-power Schottky (74LS14) is used, the substantial input sink current will have to be considered when the time constants are computed. ■

View from the Far East

There may be a Japanese microcomputer in your future. Here is one visitor's impression of our hobby as it exists in the Land of the Rising Sun.

Art Becker KH6GGO
Box 591
Pearl City HI 96782

To say that microcomputing is popular in Japan is a drastic understatement . . . microcomputing in Japan seems to be reaching nothing short of epidemic proportions. In this article I'll describe the kinds of equipment available in Japan, as well as prices, microcomputer magazines and microcomputer clubs. We'll also "visit" two microcomputer stores in Tokyo.

Akihabara

The Akihabara section of Tokyo is known as the city's electronic/electric appliance center. A large retail component trade has developed, and almost anything electronic/electrical is available there. While electric appliances and stereo equipment are most common, many specialty stores can be found, including those offering electronic components.

Many of the specialty shops are what could be termed "super" specialty shops, for they may sell *only* transformers, or *only* switches, or *only* speakers. This is really quite a change from, say, the older surplus row shops in Chicago or most U.S. retail component stores. However, many shops carry a wide variety of electronic parts, and it is probably safe to say that virtually everything is represented in Akihabara.

In regard to microcomputers, a great number of integrated circuits, including 8080As and 6800s, are available. The 8080As are manufactured by Nippon Electric Company (NEC) and others, while the 6800s are made by Motorola. All support chips are available, too. Of course, all regular modern electronic components can be had, including IC sockets (wire-wrap and regular). One IC socket that particularly caught my attention was a 42-pin socket; at the time I had no idea what type of IC used a 42-pin socket.

Many microcomputer training/evaluation kits, plus other kits for such devices as TV character generators, keyboard encoders and many Pong-type TV games, were on sale in Akihabara. Table 1 lists most of the kits available.

Prices

It is safe to say that prices for electronic equipment in Japan are higher than in the U.S.—often running up to twice the price. (The yen is rising in comparison to the dollar; prices in general always rise; and also prices vary from store to store.) Some examples follow.

Integrated Circuits		
555	¥ 200	($.75)
8080A	¥ 6420	($24)
MC6800L	¥ 7250	($27)
1702A	¥ 5000	($19)
IC Sockets		
14 pin	¥ 100	($.37)
16 pin	¥ 110	($.40)
40 pin	¥ 350	($1.30)
42 pin	¥ 370	($1.40)

I still wasn't able to find out what ICs have 42 pins.

While wandering around, I noticed a very crude breadboard selling for ¥12,700 ($48!). It was roughly equivalent to, say, a Continental Specialties ProtoBoard 6, which sells for about $16 in the U.S. LEDs of all kinds were available, and 8-segment LEDs sell for ¥350 ($1.35).

Overall, it appears that it wouldn't be terribly difficult to purchase all the components necessary for an 8080 or 6800 system, but it would be expensive, and you probably couldn't obtain everything you needed from any one dealer.

Akihabara is an experience not to be missed . . . wandering up and down the crowded aisles is like touring a permanent hamfest or computerfest Language is no problem—you point to what you want, and they are happy to sell it to you.

Japanese Microcomputer Magazines

Although the general popular electronics magazines in Japan have some feature articles about microcomputers, there are two monthly specialty magazines dedicated to microcomputing—*ASCII* and *I/O*. *I/O* was started in October 1976 with a fellow named Nishi as the editor. Prior to this, the only available microcomputer news was in the form of company newsletters, generally extolling the virtues of that company's product.

In the middle of 1977, Nishi left *I/O* and started *ASCII*. The physical size of *I/O* is about the same as the "old" *73 Magazine* and runs about 75-100 pages monthly; *ASCII* is the size of the "new" *73 Magazine* and runs 50-60 pages monthly, with full-color covers. *I/O*'s newsstand price is ¥350 ($1.30), while *ASCII*'s cover price is ¥440 ($1.65). *ASCII* also operates a book service, selling such items as single copies of *Kilobaud* for ¥1000 ($3.75) plus postage.

Leafing through both magazines is quite an experience. Even if you don't read Japanese, you can discover a great deal about Japanese microcomputing. Both magazines have distributed software on flexible phonograph records included in the issue. The Japanese call these soft plastic records sonosheets.

I/O offered 6800 4K BASIC, 8080 2K BASIC, and an 8080 TV game on one sonosheet, while *ASCII* offered 6800 4K BASIC on its sonosheet. Listings were provided in both magazines. The 6800 4K BASIC is SWTP 4K BASIC Version 2.0, and the 8080 2K BASIC is Palo Alto Tiny BASIC. Tones used are 1200/2400, and rates are 300 baud for the 6800, and 110 baud for the 8080.

Feature articles in *ASCII* included a review of the Commodore PET, written by publisher Nishi, who claims to have the most PET experience of anyone in Japan.

The advertisements were sometimes surprising. For example, one of the first ads I came across was for little Rickey and his SDK-80. All the copy was, of course, in Japanese. Intel, by the way, is firmly

established in Japan. I managed to talk with Dr. Nobuo Kamata of Intel, and I was very impressed with the company's Japanese-language sales literature. You could just tell that it was presenting good, solid information (hint: the buzzwords are all in English!). Other advertised items included the Apple II, ADM-3A kit at ¥490,000 ($1850), and Seals 8K memory at ¥85,000 ($320).

It is extremely frustrating, though, to leaf through a Japanese microcomputer magazine. You just *know* it is crammed full of interesting and useful material . . . if only you understood Japanese.

ASCII Publisher Nishi

Kilobaud suggested I contact Nishi, the publisher of *ASCII*, for some background information on microcomputing in Japan. They kindly provided me with *ASCII*'s address.

After some initial difficulties, I found it and entered what appeared to be the office of an average microcomputer-magazine publishing company. Stack of magazines and books, several desks, a copy machine, and mountains of pasteups covered almost every square inch (millimeter?) of the office.

The sole occupant was a young woman named Hiroko Tachizawa. She looked up with the same half-startled, half-horrified expression that you see on the faces of so many Japanese when a strange *gaijin* (foreigner) suddenly pops in, miles and miles away from where *gaijin* are normally found. Miss Tachizawa took a deep breath, gathered her courage and set out to find out what I wanted, or was going to do.

I started to move from the doorway into the office when she gasped and pointed at my feet . . . shoes. I had committed the Japanese *faux pas* of entering a room without taking off my shoes. At that moment, in walked Kei Tsukamoto, who took over the task of dealing with me.

I managed to convey that I was writing an article for *Kilobaud*, and that I wished to talk with Nishi. Well, at that moment, Nishi was in the United States! However, he was to return soon, so I left a message. Nishi called a few days later, and we arranged a meeting.

Japanese microcomputer magazines and sonosheet software. *(Photo by Michael Mochizuki)*

Nishi (photo on page 3, *Kilobaud* No. 8) and I talked for quite some time on two occasions, and he related the following information about himself and microcomputing in Japan.

- In 1976, NEC introduced its microcomputer training kit. In six months it sold 5000 units.
- Nishi started *I/O* in response to an intuitive need for a specialized publication in the field. *I/O*'s staff was made up of university students. In January 1977, they obtained a Z-80 chip, and within a week had designed and constructed a working microcomputer.
- Nishi has been to the United States several times, and has taken courses at the University of Hawaii. He mentioned that there is really no university-level course on microcomputing in Japan.

During our first talk, I was introduced to more *ASCII* staff members: Mr. Gunji, Mr. Ono and Ms. Ayako Kurakami. *ASCII*'s mailing address and phone number are:

ASCII Publishing
305 HI TORIO
5-6-4 Minami-Aoyama,
Minato-ku
Tokyo, 107, Japan
(03) 407-4910

Tokyo Microcomputer Stores

There are many microcomputer stores in Tokyo, and a lesser number in the rest of the country. Two that I visited were Moonbase and Cosmos, both near Shinjuku station in Tokyo. Shinjuku station is a small town in itself, with over ten different train and subway lines either terminating or passing through it, plus several layers of shopping arcades.

About a block and a half west of the south end of Shinjuku station, across from the Keio department store, on the south side of Koshu-Kaido Avenue, is Moonbase computer store. Don't bother asking any Japanese where Koshu-Kaido Avenue is, for they rarely know street names; their system is to identify major intersections, which have their own names, and fan out from there. However, Shinjuku station and Keio department store are listed in every English-language map.

My first impression of Moonbase was that it was a clean, bright, modern display office. I expected everybody to drop what they were doing to stare at the strange, tall *gaijin* who somehow managed to break the secret code and locate their store. Instead, the eight people huddled around a terminal playing Star Trek were so intently interested in the game that I imagine Godzilla could have entered to encounter the same lack of response. This left me to wander about, first checking to see if everyone had their shoes on or not (they did).

Moonbase offers many microcomputer books in Japanese, including a Japanese translation of Albrecht's *My*

Model	CPU	Cost
Nippon Electric Company		
NEC TK-80	uPD8080A	¥88,500 $334
MP-80	8080A	¥39,500 $150
Motorola		
MEK6800DIIA	MC6800L	¥79,000 $300
MK-80	Am9080 or uPD8080A	¥68,000 $257
Hitachi H68/TR	6800	¥99,500 $375
PANAFACOM LKIT-8	MB8861 (6800)	¥85,000 $320
INTEL SDK-80	8080A	¥83,000 $313
Toshiba EX-5	(12 bit)	¥77,000 $290
PANAFACOM LKIT-16	MN1610 (16 bit)	¥98,000 $370

Table 1. Japanese microcomputer training kits. With the exception of the Toshiba EX-5, all have hex keyboards with additional function keys, and 8-segment LED displays. All seem to have additional workspace on the PC board.

Computer Likes Me. Available English language books included the Osborne series, all current U.S. microcomputer magazines and the Motorola 6800 manuals. Some of the microcomputer training kits listed in Table I were also available.

The Star Trek group centered around a young man trying to teach his girlfriend to play, and having the same results I've observed in America. They were using an LSI ADM terminal connected to an Altair 8800A (plenty of Altairs are available in Japan).

A sampling of what Moonbase had to offer includes the following three power supplies: (1) An MMA-1A had 5V @ 5 A and ±12 V, both @ 1 A. The cost was ¥37,800 ($143). (2) A single voltage supply, the AP5 0510, offered 5 V @ 1 A, and sold for ¥12,200 ($46). (3) The AP5 OJ30 offered 5 V @ 3 A and cost ¥20,300 ($77).

When I bought a Japanese language microcomputer magazine, the attractive clerk asked me if I could read Japanese. I lied through my teeth and answered, "Yes, a little." Somehow I just couldn't bring myself to tell her that I bought it for the pretty pictures.

Cosmos Computer Shop, the other computer store near Shinjuku, is a division of Astar International. Astar specializes in reconditioning electronic and electromechanical peripherals, which is its main source of income. Cosmos also handles used microcomputer equipment, and sells new equipment, such as Mits, Apple, Imsai, KIM, and so on. Cosmos/Astar has several branches all over Japan, as well as an American branch at 210 North Garfield Avenue, Monterey Park CA 91754, (213) 573-9000.

I talked with the manager, Yoshifumi Hamada, and tea was served. Mr. Hamada had Cosmos's chief English speaker, Shimizu Osanu, sent out of the engineering department. Shimizu is also a ham (JA1JQO).

Our discussion, which took several hours, was mostly an interview of me. "How many Byte Shops in America?" "How many visitors per day at the average American Byte Shop?" "What is the income of the average American Byte Shop?" I stumbled through the answers as best I could.

During the time I was there, many customers came and went. It was evident that some were there for the first time because they were clutching Japanese microcomputer magazines with handy locator maps in the ads (handy if you read Japanese, that is). Serious customers were served tea.

Cosmos was most proud of their latest product, the Cosmos Terminal D. The terminal (less TV set) is, in actuality, a complete microcomputer system plus, and apparently does everything but plug in the morning coffee (or tea). The assembled and tested price is about $1300. It is bus compatible with the HP-IB (known alternately as either the Hewlett-Packard Interface Bus, or the Home and Personal Interface Bus).

The Cosmos Terminal D has either an MCM6800 or FACOM 8861 CPU, 7 x 9 dot matrix (no graphics), 64 x 16 or 32 x 16 display, 75 to 9600 baud rate, scrolling, seven-color generator (or B/W or W/B), TTY interface, cassette interface, hardcopy interface, Mikbug, plenty of RAM and full compatibility with SWTP software. One of its more interesting features is its built-in PROM writer. Memory can be extended to the full 64K. Any selections that must be made (baud rate, display size, etc.) can be made from the keyboard. The Cosmos Terminal D was only announced a month before my visit, and they already had 100 preproduction orders.

Publisher Conference

During my stay in Tokyo, I was invited to attend a meeting at the Tokuma Publishing Company in the Shimbashi section of Tokyo. Tokuma was considering publishing a new introductory book about microcomputing. Previous works were engineer-oriented, so Tokuma felt that a non-engineer introductory book was feasible, and wanted to explore the potential market. Nishi from *ASCII*, Hamada from Cosmos and Kamata from Intel also attended.

Among topics discussed was the Japanese bus controversy (no reason why Japan should be immune from such problems). It is generally agreed in Japan that the Altair/S-100 bus is obsolete, and while the Heath/Benton Harbor bus must be taken into consideration, the Hewlett-Packard Interface Bus (HP-IB) seems best suited for the Japanese microcomputer industry. In fact, this was the topic of many articles in current Japanese microcomputer magazines. The meeting took about an hour and a half, food was catered, the proceedings were tape-recorded, and the company photographer took pictures.

Japanese Microcomputer Clubs

I met with Mr. Koji Yada of the Japan Microcomputer Club, and he provided me with English language abstracts of *Micro Computer News*, the club's digest. The club has well over 600 members, with branches all over Japan. One article that caught my eye was a short story presented at one of the meetings. Its title was *Kagezen*, and the abstract states, "It is a sorrowful story about a young wife whose husband is a very diligent microcomputer technician."

While it is acknowledged that most microcomputer technology comes to Japan from America, the club's chairman, Shigeru Watanabe, states that it is very important for Japan to create unique Japanese microcomputer products. If Japan merely produces foreign designed products cheaply and exports them, friction will always develop between the countries. The Japan Microcomputer Club may be contacted through:

Mr. Koji Yada, Manager
Computer Center
Tanashi Branch
Electrotechnical Laboratory
5-4-1, Mukodai, Tanashi
Tokyo, Japan

Conclusion

Microcomputing is growing by leaps and bounds in Japan. If you are a vendor/dealer/manufacturer, you will be wise to consider the huge Japanese microcomputer market. If you are a tourist, you will have the time of your life there. A statement I've heard about the Japanese people in general certainly applies to microcomputing there: The Japanese are overachievers. I can hardly wait for my next visit. ■

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Use That Parity Line!

If 128 ASCII combinations sometimes aren't enough, try using the often forgotten parity bit for added flexibility.

Sid Owen
246 Walter Hays Dr.
Palo Alto CA 94303

Many hobbyists find that with only 128 possible bit combinations with the seven-bit ASCII code, there are not enough keys on the keyboard for all the commands they would like to send. When you subtract 94 printing characters and about a half dozen printer controls (carriage return, tabulator, etc.), there are not many keys left for cursor control, switching functions and call-up of frequently used routines. I had every key assigned to some function and needed more code combinations soon after completing my system. Other hobbyists have a capital-only keyboard and encoder ROM, but have a montior or printer with both lowercase and uppercase capability they cannot fully utilize.

There is a simple solution for both problems: use the parity line! The ASCII code uses seven bits for data and the eighth (MSB) bit for parity. The keyboard ROMs generate the parity bit, and most hobbyists wire it along with the seven data bits through the I/O interface, but then discard the parity bit with their software.

Program 1 shows the beginning of a typical program that strips off the parity bit. This bit is essential where noise or high reliability is a problem, but it is rarely useful for the keyboard-to-computer link of small systems.

Since you have this unused parity wire from your keyboard through the I/O interface and it is read along with every character that you key – use it! Disconnect this wire from the keyboard ROM and switch it between 0 and 5 volts with an added key-switch, a toggle switch or both. Fig. 1 shows one simple method of doing this. That is the only hardware change needed. You have now doubled the useful codes from your keyboard.

Program 2 shows a short addition to your software to utilize the added capability. With the switches off, the ASCII codes are read and used exactly as before, but if the new key is depressed, the program jumps to a new memory location. Each of the added 128 ASCII characters can be assigned a new function. You can, for instance, call up any of 128 programs with a single keystroke.

By using the new key as a shift key, uppercase-only keyboards can be converted to uppercase and lowercase capability. As shown in Program 3, if the key is now depressed, the software

0000	DB43	IN	Read keyboard status
0002	E680	ANI	New character ready?
0004	CA0000	JZ	If not, try again
0007	DB44	IN	Read keyboard
0009	E67F	ANI	Discard parity bit
000B	.	.	.
	.	.	.

Program 1. The parity bit is usually discarded in small systems.

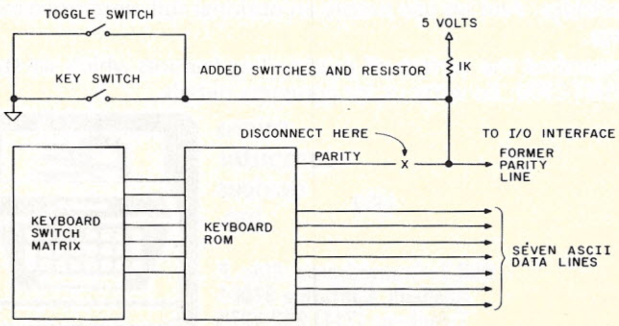

Fig. 1. Simple hardware change to use the parity line.

0000	0680	MVI B	Load B with bit 8=1
0002	DB43	IN	Read keyboard status
0004	E680	ANI	New character ready?
0006	CA0200	JZ	If not, try again
0009	DB44	IN	Read keyboard
000B	B8	CMP B	Is bit 8=1?
000C	DA0001	JC	If not, jump to 0100
000F	E67F	ANI	Discard parity bit
0011	.	.	(Continue, same as before)
	.	.	.
0100	(Start of new routines to use 128 added characters)		

Program 2. Software example to use added capability.

changes bit 6 from 0 (as received from the keyboard) to 1. Also, since some of these keyboards do not supply bit 7, this software adds it for alphabetical characters. The resulting ASCII code then corresponds to the same letter you typed, but it is now lowercase. When the new shift key is depressed, this program step is jumped, and the character remains a capital as generated by the keyboard.

You do not need to be limited by your keyboard's capacity — addition of this one switch doubles the number of possible bit combinations. ■

```
0000   012080   LXI B   Load B with bit 8=1; C with bit 6=1
0003   DB43     IN      Read keyboard status
0005   E680     ANI     New character ready?
0007   CA0300   JZ      If not, try again
000A   DB44     IN      Read keyboard
000C   E6BF     ANI     Make bit 7=0
000E   B8       CMP B   Is bit 8=1 (lowercase)?
000F   DA1C00   JC      If not, jump
0012   A8       XRA B   Make bit 8=0
0013   B9       CMP C   Is bit 6=1 (numerals)?
0014   D22200   JNC     If so, jump
0017   F660     ORI     Make bits 6 & 7=1 (ASCII lowercase letters)
0019   C22200   JMP     Jump; finished with lowercase
001C   B9       CMP C   Is bit 6=1 (numerals)?
001D   D22200   JNC     If so, jump
0020   F640     ORI     Make bit 7=1 (ASCII letters)
0022   .        .       (Continue original program from here)
.      .        .       .
```

Program 3. Software example to generate lowercase ASCII code, including bit 7, from uppercase-only keyboards.

The Software Patchcord

Tape duplication problems in some systems are overcome with a short software routine.

Marc I. Leavey, M.D.
4006 Winlee Rd.
Randallstown MD 21133

Hey Ric, can you make me a copy of that new Phenotyping Determination program you've been working on?"

"Sure, Marc. Let's see – all I have to do is plug this recorder into the other one. Now, where is that patchcord? Oh, here we go. Hmmm . . . got to reset the levels; oh well, we'll set it back up for the computer later. Okay! Here we go . . ."

Sound familiar? You end up with an audio-dubbed tape with some extra wow, flutter and non-digital garbage, and your benefactor faces reconnecting and resetting his cassette decks. But to owners of equipment such as the SWTP M-68 computer and AC-30 cassette interface, this has been the only way to dub a tape. No provision is made to directly connect the output of the player to the recorder. The technique described in this article allows a short program to be entered into the computer, which allows such a transfer without hardware changes.

The monitor of the MP-68, whether the original MIKBUG or the newer SWTBUG, provides that any character entered from the terminal be echoed back, unless otherwise defeated. All we have to do is use this routine, while preventing the CPU from acting on any input. The simplest way to do that is to tie the computer up in an endless loop, which never looks at the output or input. Fig. 1 illustrates the program used to do that.

The program is entered in the "scratchpad RAM" beginning at location A04A(hex). It executes a "NOP," which does nothing, then an unconditional branch back to the beginning. This clearly satisfies our requirements: it does nothing, then loops forever doing nothing more!

The program may be entered directly from the keyboard using the Memory Examine function of the monitor, or a tape may be prepared. A standard Motorola format tape is:

S108A048A04A0120FD07S9.

To use the Software Patchcord, merely enter the program into memory and hit "G." The terminal will respond with nothing. At that point, set the RECORD and PLAY switches of the AC-30 to ON, and start the tapes – record one first, then the one to be copied. All data being recorded will be displayed on the terminal, so following the duplication process is very simple. When the transfer is complete, stop the recording machine, then the playing one, and RESET the computer.

This may be used for MIKBUG, SWTBUG, or BASIC tapes, or even special or odd tapes. The technique merely copies from one tape to another; it does nothing with the data, nor does the computer need to understand it.

There you go; now all you software freaks will have no excuse when your buddy asks for a copy of your latest creation. ■

```
PAGE 001 SOFTWARE

00010                          NAM    SOFTWARE PATCHCORD
00020                          OPT    O,S

00040                   * PROGRAM DESIGNED TO PERMIT SWTBUG OR MIKBUG
00050                   * TO PROVIDE AN ECHO FOR TAPE DUPLICATING

00070  A048                    ORG    $A048
00080  A048 A04A PGMCTR        FDB    START     * SET UP PROGRAM COUNTER
00090  A04A 01    START        NOP              * DON'T DO ANYTHING
00100  A04B 20 FD              BRA    START     * AND DO IT AGAIN
00110                          END
PGMCTR A048
START  A04A
```

Fig. 1.

modem / 'mo • dəm / [**mod**ulator + **dem**odulator] *n* - *s* : a device for transmission of digital information via an analog channel such as a telephone circuit.

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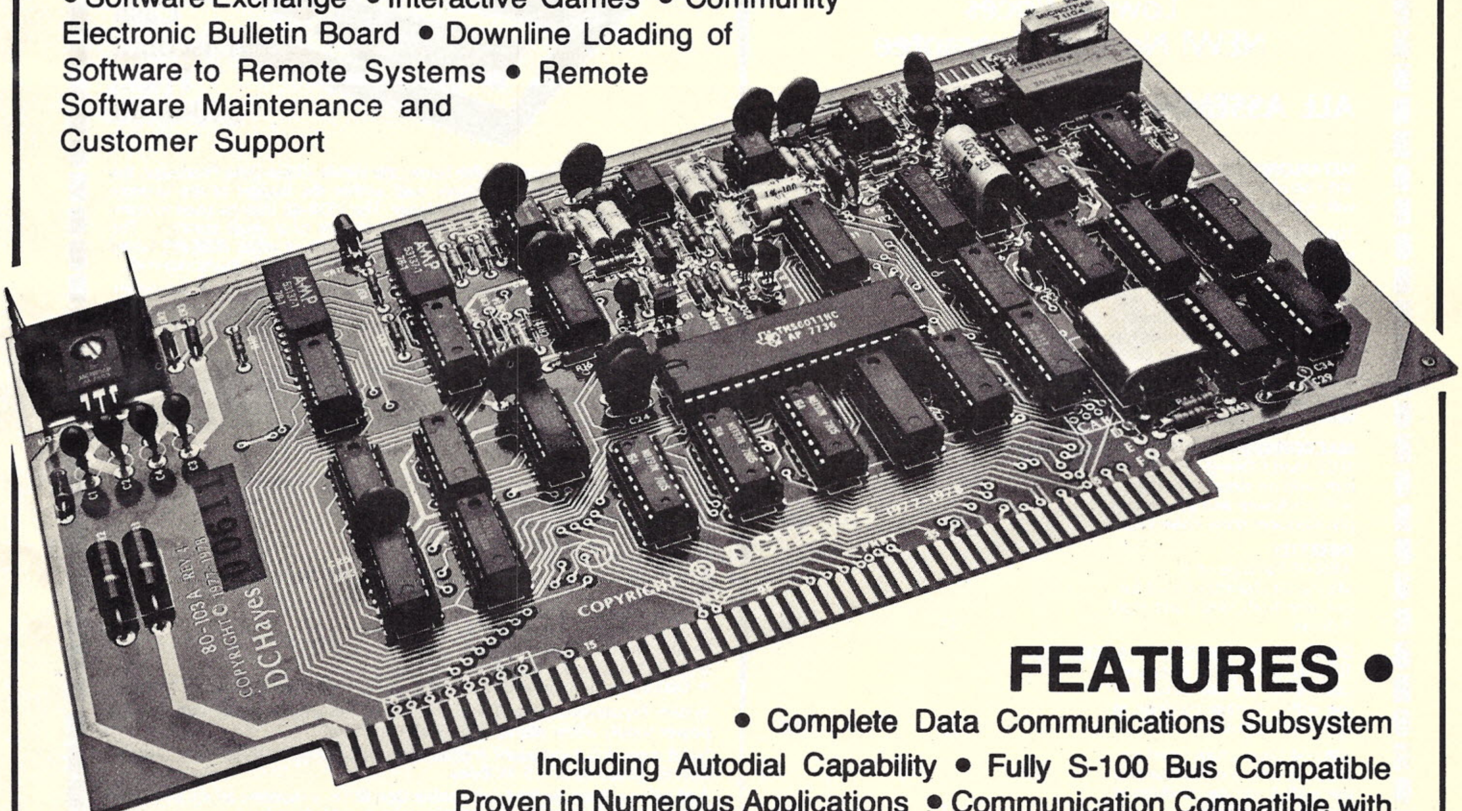

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Regulated power supplies, tested working 5 V @ 25 Amp, $95, freight collect, UPS. A. Khan, 2355 Burch Cir., N.E., Atlanta GA 30319. (404) 325-0089.

TRS-80 Level I 4K—5 pop. games. Orig.—graphics & score—cassette, $7. C. Zalnerunas, 3034 W. Columbus Ave., Chicago IL 60652.

North Star Software Specials: Investment Analysis Package: $25. Home/Family Package: $25. Game Pack: $15. All these disks are full and just packed with programs! Order now or write for complete list. Herbert Schildt, 1007 N. Division, Urbana IL 61801.

TRS-80—Several business and accounting programs available on cassette. Depreciation, financial analysis, income tax, interest calculations, real estate selection and evaluation and more. Write: C. Jones, 658 Edinboro Rd., NW, Atlanta GA 30327.

TRS-80 OWNERS!! Original software including business system for Amway Distributors. Level I & II versions available. All will run in 4K. Also have moving signboard machine-language program. Write for info. Allan E. Sitter, 8 Driftwood Circle, Groton CT 06340.

TRS-80, PET & Apple II reference list of software on cassettes. Published in Aug. and every 3 months. Cost is $1 to North America and $2 elsewhere. Robert Purser, Box 466, El Dorado CA 95623.

TRS-80 Monthly Newsletter. For information write to: Howard Y. Gosman, Box 149, New City NY 10956.

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*Books of computer games in BASIC. ENIGMAS-1 ($8): Gone Fishing, Concentration, Starship, Craps, Slot-Machine, Sherlock Holmes, Tank Attack. ENIGMAS-2 ($8): Number Guess, Mortar Battle, In-Between, Shell Game, Safari, Starship-2, Dice Roll, Puzzle. *Catalog and test program Frog Race, $.50. Available in Standard BASIC, SWTP 8K BASIC or Radio Shack TRS-80 BASIC. Please specify. B. Erickson, PO Box 11099, Chicago IL 60611.

TRS-80 Software: Business programs written in 16K Level II. Available for cassette or disk files. Send for list & prices. L. Owens, Rt. 6, Box 336A, Thomasville GA 31792.

TRS-80 Music Generation program; no hardware needed. Cassette (Level I and II) and instructions, $9.95. Write: D. Palmer, 815 Ky Ave., Lynn Haven FL 32444.

CIRCLE CHESS instruction book by Alphonso, used in Circle Chess software development, $5. Stanonis, Box 63, Des Plaines IL 60017.

TRS-80 Level II, 16K. Star Trek game that runs in Level II, $5.95. Other games SASE. J. Joyce, 5925 Rockhill Rd., Kansas City MO 64110.

For Sale: KIM-1, improved keyboard, 19 programs, First Book & more. $215 or SASE for more info. P. Ashley, 10 Clinton St., Portland ME 04103.

Eight 4116 300 ns dynamic RAMs, $140. (They run perfectly at 4 MHz.) Eight 4115-41 350 ns dynamic RAMs, $70. Dazzler: assembled and running, $225. Steve Sawyer, 5937 S. Yorktown, Tulsa OK 74105. (918) 747-8437.

TRS-80: Full-length simulations for 4K Level I. Pioneer, Capitalist, Survival & Space Voyage on cassette for $10. Also Football, Baseball, Lander & more for $8. All 11 for $15. To M. Flanagan, 130 Holly, Cleveland OH 44135.

KIM-1/Kimsi/8K Econoram II, almost new, $425. 9" video monitor & TVT-6 kit (unass.), $100. John (415) 824-1356 (S.F.).

TRS-80, 16K memory kits. New (100% tested), $175. Larry C. Stanley, Rt. 5, Box 131 B, Circleville OH 43113. (614) 474-1741.

STAR TREK or BIORHYTHM on Tarbell cassette. TDL (Xitan) Z-80, 8K BASIC, V. 1.3. Require 5K and 2.5K of RAM, respectively. Listing included. Send $5 for one or $8 for both to Capricorn, PO Box 8813, San Marino CA 91108.

KB CLUB CALENDAR

(from page 9)

Cleveland OH

The Cleveland Digital Group meets on the third Sunday of each month at 8700 Harvard Avenue (east of Broadway Ave.). Meeting time is 2 PM.

Canoga Park CA

Jim Zuber writes to say that the first meeting of the KIM-1 Users Club was a great success. He cites the general purpose of the club as "informal communication between fellow KIM-1 users." Future meetings have been scheduled for the second Wednesday of the month at 7:30 PM, at 20224 Cohasset, No. 16.

TRS-80 Newsletter

Information on a new TRS-80 newsletter is available from Howard Y. Gosman, Box 149, New City NY 10956.

This column is available for you to report on your club's activities such as regular meeting schedules, special events or programs, swap meets or any endeavor that will be of interest to your fellow hobbyists. If your announcement contains timely information, please send it at least two months prior to the date or dates mentioned in the announcement.

Kilobaud Club Calendar
c/o Steve Fuller
334 Sterling St. Unit A-3
West Boylston MA 01583

CORRECTIONS

Bill Welborn, author of "At Last: A Client Timekeeping System" (September 1978, p. 32), called with an informational change to the article. On page 37, top of column 3, Bill says: "But, of those [BASICs] *I am familiar with, none have the IF END* statement." That sentence should read: "But, of those I am familiar with, only a few have anything similar to the IF END statement."

Rod Hallen writes: I have just become aware of a possible problem with the software in my article in the July issue, "It's Here: Cook's Memory Test." When it was written I was using the CONSOL Personality Module that came with my SOL. Since then Processor Technology has come out with a new PROM that uses a different jump table. They also upgraded the old PROMs at no charge to the buyer. Most of the PROMs were probably upgraded. Changes in Program B are as follows:

Address	Old Op Code	New Op Code
C994	8A	19
C998	D7	E8
C999	C2	C3
C9A1	8A	19

There is a program listed in the July issue, "Revolving Charge Account Calculations," by Len Gorney, that can be shortened by about 375 bytes by readers' making the following changes. It will also run faster.

Delete:
Lines 1620-1960 (that's 35 lines)
line 1560

Insert:

```
1265 FOR K = 1 TO 12:READ M1$(K):NEXT K
1266 DATA "JAN", "FEB", "MAR", "APR", "MAY", "JUN"
1267 DATA "JUL", "AUG", "SEP", "OCT", "NOV", "DEC"
1560 M$ = M1$(Y2)
```

Nathan Myers
Hilo HI

Sherman P. Wantz
424 NW Lakeview Drive
Sebring FL 33870

Brian E. Bateman
PO Box 399
Sharpes FL 32959

A Useful Address List Program

Novices: Here's an example of what beginning programmers can accomplish. Watch for the companion article "Address List Editor" . . . coming soon.

If I can learn to program a microcomputer using BASIC, anyone can.

Just about a year ago, I saw my first computer program—a printout of Star Trek. After recovering from the shock of seeing that long list of mysterious symbols, I thought, "I'll never be able to understand programming; it's just too complicated."

I was wrong. As you will see, programming in BASIC need be neither mystifying nor difficult.

What This Program Does

Examine the program listing (Address List Program) that accompanies this article. The program is designed to print out the name, address, telephone number, birth date and age of any individual in your list of correspondents (see Example 1).

You can retrieve specific information from your list by directing the computer to search for a particular name. If you want the computer to list correspondents from a particular state, name the state, and the program directs the search. Should you want a listing of all correspondents whose birthdays occur in a particular month—so you can send birthday cards—the program will give it to you.

Finally, in addition to printing out the entire address list for your periodic updating review, the program will give you a listing of only those correspondents with whom you exchange Christmas cards (see Example 2).

How the Program Originated

The program represents a joint effort by Brian Bateman and me—both novices, but on different learning planes. I wrote the specifications for the program, but Brian was its architect. His three college courses in programming show through clearly in the subroutine that begins at line 310 and proceeds through statements 1300-1480 to produce the values deposited at line 320 needed to calculate the ages of your correspondents.

The series of calculations beginning at line 1300 is not difficult to trace (and duplicate), if your version of BASIC allows LEFT$, MID$, RIGHT$ and VAL functions. Work your way through the subroutine using pencil and paper to determine that the calculations are not really hard to understand.

Since I owned the computer, an SWTP 6800, and Brian lived more than 100 miles away, it was my assignment to test the program, discover its flaws (primarily caused by my lack of comprehension), simplify it (removing "improvements" that had a way of creeping in) and revising it. Notice particularly how few odd-numbered (last-minute corrections) statements it contains.

About Those Variables

By reading each line of the program, you will discover how easy it is to recognize what most of the variables (R, D$, N$, etc.) stand for.

For example, R in line 140 represents the number of address list names you intend to enter into your computer at any one time. The number of names you enter will depend on how much memory space remains in your computer system after you have entered 8K BASIC plus the program.

Now examine line 205. You will see an instruction telling the computer to jump to a subroutine located at line 2730. The subroutine asks you to define the variable E that instructs the computer to display information either on a video terminal or on a teleprinter at port #3.

Line 2800 directs you (and the computer) to RETURN (i.e., return to the instruction following the GOSUB 2730 command located at line 205) for the next instruction to be executed.

Now look at line 190; the string variable D$ (meaning a

```
 1    ABLE;CHARLES A.*                  1234 ZULU AVE
      LOS ANGELES;CA.90000              213/123-4321
      03-12-86                          AGE IS 91
 2    BAKER; JAMES E.                   567 YANKEE ST.
      BOSTON;MA.02100                   617/555-1234
      03-10-15                          AGE IS 62
 3    DELTA; FRANK R.*                  P.O. BOX 987
      NEW YORK; NY.10000                212/444-5432
      12-15-45                          AGE IS 32
 4    ECHO; HELEN C.                    3322 SPRING BLVD
      MIAMI;FL.33100
      00-00-00                          AGE IS UNKNOWN
```

Example 1. Fictitious four-name address list program printout.

variable that may consist of letters and/or numbers) stands for the current date. Similarly, in line 300, G represents either a 1 or 2 that tells the computer whether you intend to place your address list data into computer memory via cassette recorder or enter your list by typing its names and addresses using the computer terminal keyboard. Continue reading down the list to see how many variables you can identify.

Figs. 1 and 2 list all of the variables used in the program. Refer to them to help you understand each command and to see how variables are employed to simplify—not complicate—the computer's task.

Being able to follow a program listing depends on two factors: (1) your ability to recognize the function served by each variable used by the programmer; (2) your familiarity with the computer language being employed.

BASIC for Beginners

The Address List Program is written in BASIC, an acronym for Beginner's All-purpose Symbolic Information Code. All too often programmers tend to forget that this language was intended to simplify computer instructions for us *beginners.*

If you are a novice, you might appreciate more than others the straightforward, readable approach of this program. You should have little difficulty tracing each instruction, using pencil and paper, in the exact sequence your computer must follow.

Remember, though, that in the version of BASIC used here, multiple commands, separated by a colon, are allowed. Also, since a comma used in a string variable terminates the string, note that semicolons are used to separate the names of addressees, as well as the names of cities and states.

Forgive me for my "gee whiz" and "golly gee" attitude about the way this program turned out. If you are new to this hobby, I feel confident that you will appreciate my enthusiasm. On the other hand, if you are a professional programmer, I hope you will overlook any indications of awkwardness, inefficiency or lack of sophistication; remember how your first program looked to you after you completed it; and recall how elated you felt about its ability to serve your purpose.

Tailoring the Program

As it stands now, it takes about 6.5K of memory to use the program . . . that's in addition to the 8K of memory required by BASIC to interpret the program. You will also need memory for your address list—somewhat less than 200 bytes per correspondent, considering that each string variable requires (reserves) 32 bytes.

After you have gone through the entire program, tracing its commands and learning how it employs BASIC instructions to perform specific tasks, you will be ready to begin paring the program to make it fit more economically into the space you have available in your system.

An editor program we're currently developing will allow you to prepare a tape of your address list, modify addresses and telephone numbers, add names to your list, delete addresses, etc. If you have no teleprinter, you can save space by deleting statements 2350-2440 and rewriting lines 2730-2800 to eliminate the display mode option. The age calculation subroutine (lines 1300-1480) can be deleted if you have no interest in the ages of your correspondents.

All statements reading "PRINT CHR$(16);CHR$(22)" can be eliminated if you intend to use your video terminal in its

```
1    ABLE;CHARLES A.*          1234 ZULU AVE
     LOS ANGELES;CA.90000      213/123-4321
     03-12-86                  AGE IS 91
3    DELTA; FRANK R.*          P.O. BOX 987
     NEW YORK; NY.10000        212/444-5432
     12-15-45                  AGE IS 32
```

Example 2. Printout of Christmas card mailing list from names in Example 1.

N	Prevents "turn teleprinter on" instruction from being repeated.
R	Designates number of addresses to be entered into memory from tape at any one time.
S	Identifies each search routine (name search, state search).
X$	Means "unknown." Used when addressee's birth date not given.
E	Designates information display mode selected (either CRT monitor or teleprinter).
D$	Current day's date.
N$	Addressee's name.
A$	Addressee's street address.
C$	Addressee's city, state and zip code.
P$	Addressee's telephone number.
B$	Addressee's date of birth.
U$	"9" used to inform computer that it has received its last address entry.
M	Counts the number of addressees to be displayed on monitor screen.
I	Counts addressee data being input from tape.
G	Identifies option of method to be used to enter address list into memory—either from tape or from keyboard.
Y	Represents a number generated by processing current date through subroutine-age calculation.
D	Represents a number generated by processing current date through subroutine-age calculation.
C	Same as above.
F	Same as above.
K	Identifies desired information search routine.
J	Flag used to indicate whether or not information being sought has been located.
T$	Identifies specific information sought from address list program.
P	Identifies addressee names retrieved from memory in name search subroutine.
H	Identifies number of characters in addressee's name during search subroutine.
U	Flag used to designate continuation point in program after search or input of list.
Q$	Represents last eight characters of addressee's city, state and zip code (i.e., the two-letter state abbreviation, a space or period and five numbers in zip code).
R$	Represents leftmost two characters of Q$ (i.e., the state abbreviation).
C	Represents the number value of the string variable that follows the VAL function.
Z$	Represents specific digits in the current date and in addressee's birth date entered into memory by the user.
B	Represents sums of digits used in age calculation.
A	Addressee's calculated age.
F$	Calculated age of addressee used in printout routine.
V$	Identifies "continue" or "terminate" decision.
L	Represents maximum number of addressees to be listed using keyboard.
W$	Indicates that teleprinter is ready to receive and print information sent to it via Port #3.
H$	Indicates that cassette recorder is ready to transfer information to computer memory.
J$	Used to hold information on monitor screen until it has been noted or copied by user.

Fig. 1. Program variables used (listed in order of appearance).

Program listing.

```
0010 REM ADDRESS LIST PROGRAM
0020 REM PREPARED BY B. BATEMAN AND S. WANTZ
0030 REM FOR DETAILS, SEE KILOBAUD ISSUE #
0040 REM PROGRAM RUNS IN SWTPC 8K BASIC, VERSION 2.0
0050 REM PROGRAM LENGTH: 6.5K BYTES
0080 PRINT CHR$(16);CHR$(22)
0100 PRINT TAB(10);"ADDRESS LIST PROGRAM"
0110 PRINT : N=0
0120 PRINT :PRINT"TYPE THE MAXIMUM NUMBER OF NAMES YOU WISH"
0130 PRINT "TO PLACE INTO MEMORY AT ANY ONE TIME"
0140 PRINT : INPUT "NUMBER OF NAMES", R
0150 LINE= 0: S=0 :X$="UNKNOWN": E=0
0160 PRINT :PRINT CHR$(16);CHR$(22)
0170 PRINT TAB(5);"TYPE IN TODAY'S DATE USING MONTH-DAY-YEAR"
0180 PRINT TAB(5);"PATTERN: XX-XX-XX"
0190 PRINT : INPUT "DATE ",D$
0200 DIM N$(R),A$(R),C$(R),P$(R),B$(R)
0205 GOSUB 2730
0210  U$="9": M=0: I=0
0220 IF S>0 THEN 2550
0230 PRINT :PRINT CHR$(16);CHR$(22)
0240 PRINT "TYPE ONE OF THE FOLLOWING NUMBERS TO INDICATE"
0250 PRINT "HOW YOU INTEND TO INPUT YOUR ADDRESS LIST.":PRINT
0260 PRINT :PRINTTAB(5);"1--FROM TAPE CASSETTE--LIST PREVIOUSLY"
0270 PRINT TAB(8);"PREPARED USING ADDRESS EDITOR PROGRAM."
0280 PRINT :PRINTTAB(5);"2--FROM KEYBOARD--LIST NOT PREVIOUSLY"
0290 PRINT TAB(8);"STORED ON TAPE.":PRINT
0300 INPUT "INFORMATION ENTRY NUMBER ",G
0310 GOSUB 1300
0320  Y=C:F=D
0330 IF G=2 THEN 1850
0370 PRINT :PRINT CHR$(16);CHR$(22)
0380 PRINT "TYPE ONE OF THE FOLLOWING INSTRUCTION NUMBERS:"
0390 PRINT TAB(10);"1--SEARCH FOR SPECIFIED ADDRESSEE"
0400 PRINT TAB(10);"2--LIST ALL ADDRESSEES KNOWN IN SPECIFIED STATE"
0410 PRINT TAB(10);"3--LIST PERSONS WHOSE BIRTHDAYS OCCUR IN"
0420 PRINT TAB(13);"SPECIFIED MONTH"
0430 PRINT TAB(10);"4--PRINT XMAS CARD MAILING LIST"
0440 PRINT TAB(10);"5--LIST ALL ADDRESSEES"
0450 PRINT TAB(10);"6--EXIT FROM PROGRAM":PRINT
0460 INPUT "INSTRUCTION NUMBER ",K:J=0: PRINT:PRINT
0470 ON K GOTO 500,680,850,1020,1150,9999
0500 PRINT :PRINT CHR$(16);CHR$(22)
0510 PRINT TAB(5);"TYPE ADDRESSEE'S LAST NAME":PRINT
0520 INPUT "LAST NAME ",T$: PRINT
0530  S=1: IF G=1 THEN 2500
0540 FOR P=1 TO I
0545 IF N$(P)=U$ THEN 370
0550 IF LEFT$(N$(P),2)=LEFT$(T$,2) THEN 570
0560 GOTO 640
0570 FOR H=3 TO 32
0580 IF LEFT$(N$(P),H)=T$ THEN 600
0590 NEXT H
0600  D$=B$(P): J=1
0610 GOSUB 1300
0620 GOSUB 2810
0640 NEXT P
0650 GOSUB 2870
0660 IF J=0 GOSUB 1730
0670 ON U GOTO 210,370
0680 PRINT :PRINT CHR$(16);CHR$(22)
0690 PRINT TAB(5);"TYPE ABBREVIATION FOR STATE IN THIS FORMAT:XX"
0700 INPUT "STATE ",T$:PRINT
0710  S=2: IF G=1 THEN 2500
0720 FOR P=1 TO I
0725 IF N$(P)=U$ THEN 370
0730  Q$=RIGHT$(C$(P),8)
0740  R$=LEFT$(Q$,2)
0750 IF R$=T$ THEN 770
0760 GOTO 800
0770  D$=B$(P): J=1
0780 GOSUB 1300
0785 PRINT CHR$(16);CHR$(22)
0790 GOSUB 2810
0800 NEXT P
0810 GOSUB 2870
0820 IF J=0 GOSUB 1730
0830 ON U GOTO 210,370
0850 PRINT :PRINT CHR$(16);CHR$(22)
0860 PRINT TAB(5);"TYPE BIRTHMONTH OF INTEREST USING TWO-DIGIT"
0870 PRINT TAB(5);"NUMBER-OF-MONTH FORMAT: XX"
0880 INPUT "MONTH ",T$:PRINT
0890 PRINT :PRINT CHR$(16);CHR$(22)
0900  S=3: IF G=1 THEN 2500
0910 FOR P=1 TO I
0915 IF N$(P)=U$ THEN 370
0920 IF LEFT$(B$(P),2)=T$ THEN 940
0930 GOTO 970
0940  D$=B$(P): J=1
0950 GOSUB 1300
0955 PRINT CHR$(16);CHR$(22)
0960 GOSUB 2810
0970 NEXT P
0980 GOSUB 2870
0990 IF J=0 GOSUB 1730
1010 ON U GOTO 210,370
1020 PRINT :PRINT CHR$(16);CHR$(22)
1030 PRINT TAB(5);"NAMES ON XMAS CARD MAILING LIST"
1040 PRINT : S=4: IF G=1 THEN 2500
1050 FOR P=1 TO I
1055 IF N$(P)=U$ THEN 370
1060 IF RIGHT$(N$(P),1)="*" THEN 1080
1070 GOTO 1110
1080  D$=B$(P): J=1
1090 GOSUB 1300
1095 PRINT CHR$(16);CHR$(22)
1100 GOSUB 2810
1110 NEXT P
1112 IF N=1 THEN 1140
1120 GOSUB 2870
1130 IF J=0 GOSUB 1730
1140 ON U GOTO 210,370
1150 PRINT TAB(10);"COMPLETE ADDRESS LIST"
1155 PRINT CHR$(16);CHR$(22)
1160 PRINT : S=5: IF G=1 THEN 2500
1170 FOR P=1 TO I
```

CHR$(16)	Cursor "home up."
CHR$(22)	Clear screen.
STR$(A)	Assigns the calculated age to F$.
LEFT$(N$(P),2)	Examines leftmost two letters of addressee's name whose sequential identification number is "P."
RIGHT$(C$(P),8)	Examines the rightmost 8 characters of addressee's name whose sequential identification number is "P."
MID$(D$,4,2)	Examines the fourth, plus two additional numbers in the current date or birth date entry.
CHR$(17)	Turn tape recorder "on" command.
CHR$(19)	Turn tape recorder "off" command.

Fig. 2. Special string functions.

scroll mode only. These statements (80, 160, 230, etc.) were included to cause the cursor to home up and clear the screen of previously written material before new information was printed. Neither instruction is needed if you use scrolling exclusively.

The deletions suggested above should present a challenge to the novice because very seldom can entire sections of a program be lifted without having their absence reflected elsewhere.

At the risk of being redundant, let me urge you novice programmers to use your pencils and papers to trace the program, line by line, to discover exactly where each of the portions to be deleted fits. You will learn which of the existing statements must be modified to allow the program to function without the parts you remove.

We have already removed from the program all statements that scolded the user when he answered an INPUT request with an unacceptable response. If the program directed you to type a 1 to obtain some desired result or a 2 to order another, we felt that you should be able to enter one of those two numbers and not type a 9. If you were to accidently press the wrong key, BASIC would respond with an error message to tell you that you goofed.

Professionals may chuckle when they read statements 2360 and 2520; but such reminders are essential to us neophytes who are still bewildered by the many controls we have to master to operate our computer systems properly.

In Summary

Besides being useful, in itself, the Address List Program can help you develop your programming skills. The program listing, having been prepared by novice programmers, is relatively easy to read and interpret. Its architecture is designed to support removal of entire program sections, if desired, to conserve memory.

Since the SWTP 8K BASIC requires the programmer to spell all commands (PRINT, INPUT, GOTO, etc.), instead of abbreviating them (P., IN., G., etc.) as do some versions of BASIC, the program listing is much easier to read, even though it inefficiently uses memory space.

It is essential that you become thoroughly familiar with the version of BASIC for which your computer has been programmed. The computer, once programmed, is inflexible—if it expects a colon between commands using the same line number, it won't accept a comma.

How do you learn your machine's BASIC language? Read your user's guide carefully and practice, practice, practice.

As Wayne Green, publisher of *Kilobaud,* wrote in a *73*

```
          ADDRESS LIST PROGRAM

TYPE THE MAXIMUM NUMBER OF NAMES YOU WISH
TO PLACE INTO MEMORY AT ANY ONE TIME

NUMBER OF NAMES? 10


    TYPE IN TODAY'S DATE USING MONTH-DAY-YEAR
    PATTERN: XX-XX-XX

DATE ? 02-15-78

TYPE ONE OF THE FOLLOWING NUMBERS TO INDICATE HOW
YOU WISH TO PRESENT ADDRESS LIST INFORMATION.

    1--DISPLAY ON CRT MONITOR

    2--DISPLAY ON TELEPRINTER

INSTRUCTION NUMBER ? 2


TYPE ONE OF THE FOLLOWING NUMBERS TO INDICATE
HOW YOU INTEND TO INPUT YOUR ADDRESS LIST.

    1--FROM TAPE CASSETTE--LIST PREVIOUSLY
       PREPARED USING ADDRESS EDITOR PROGRAM.

    2--FROM KEYBOARD--LIST NOT PREVIOUSLY
       STORED ON TAPE.

INFORMATION ENTRY NUMBER ? 2




TYPE NAME USING THE PATTERN:LAST NAME:FIRST
NAME MI.(XXXXX;XXXXX X.) PLACE A '*' IMMEDIATELY
AFTER NAME IF PERSON IS ON YOUR XMAS CARD LIST

TYPE '9' IF THERE ARE NO MORE NAMES
TO BE ADDED TO YOUR LIST

NAME ?


TYPE STREET ADDRESS--PATTERN NOT IMPORTANT

STREET ?


TYPE CITY: STATE AND ZIP CODE
USING THIS PATTERN: XXXXX;XX.XXXXX

CITY: STATE & ZIP ?


TYPE PHONE NUMBER--PATTERN NOT IMPORTANT
IF PHONE NUMBER IS UNKNOWN, HIT 'RETURN' KEY

PHONE NUMBER ?


TYPE BIRTHDATE. USE MONTH-DAY-YEAR PATTERN:
XX-XX-XX. IF BIRTHDATE IS NOT KNOWN, TYPE 00-00-00

BIRTHDATE ?


TYPE NAME USING THE PATTERN:LAST NAME;FIRST
NAME MI.(XXXXX;XXXXX X.) PLACE A '*' IMMEDIATELY
AFTER NAME IF PERSON IS ON YOUR XMAS CARD LIST

TYPE '9' IF THERE ARE NO MORE NAMES
TO BE ADDED TO YOUR LIST
```

Sample printout using keyboard option.

Magazine editorial: "One fact you are going to have to face ... hard fact ... programming is not going to be very meaningful to you until you have some hardware to get your hands on and learn by doing."

To that statement, we say "Amen." ■

SWTP users will soon be able to purchase this program on cassette through Kilobaud's *Instant Software. Watch for the ads in future issues of* Kilobaud.

```
1175 IF N$(P)=U$ THEN 370
1180  D$=B$(P): J=1
1190 GOSUB 1300
1200 GOSUB 2810
1210 NEXT P
1212 IF N=1 THEN 1220
1215 GOSUB 2870
1220 ON U GOTO 210,370
1300 REM * * * SUBROUTINE --AGE * * *
1310  Z$=LEFT$(D$,2)
1320  C=VAL(Z$)
1340  B=C*10000
1350  Z$=MID$(D$,4,2)
1360  C=VAL(Z$)
1370  B=B+C*100
1380  D=B
1390  Z$=RIGHT$(D$,2)
1400  C=VAL(Z$)
1410  B=D+C
1420 REM AGE=A
1430 IF D=0 THEN 2680
1440 IF Y<C THEN A=100-C+Y
1450 IF Y>C THEN A=Y-C
1460 IF D>F THEN A=A-1
1470  F$=STR$(A)
1480 RETURN
1600 REM * * * SUBROUTINE--PRINT(MONITOR) * * *
1610  M=M+1: PRINT
1620 PRINT TAB(5);N$(P);TAB(35);A$(P)
1630 PRINT TAB(5);C$(P);TAB(35);P$(P)
1640 PRINT TAB(5);B$(P);TAB(35);"AGE IS ";F$
1660 IF M<3 THEN 1700
1670  M=0: GOSUB 2870
1700 RETURN
1730 REM * * * SUBROUTINE--CHECK * * *
1740 PRINT :PRINT CHR$(16);CHR$(22)
1750 PRINT "--- DESIRED INFORMATION NOT FOUND ---"
1760 GOSUB 1780
1770 RETURN
1780 REM * * * SUBROUTINE--DECISION * * *
1790 PRINT
1800 PRINT "TYPE 'C' TO CONTINUE OR 'T' TO TERMINATE"
1810 PRINT : INPUT "'C' OR 'T' ",V$
1820 IF V$="T" THEN 370
1830 RETURN
1850 REM * * * PRINT LIST FROM KEYBOARD * * *
1860 PRINT :PRINT CHR$(16);CHR$(22)
1920 PRINT :FOR L=1 TO 100
1925 PRINT : PRINT: S=0: U=2
1930 PRINT "TYPE NAME USING THE PATTERN:LAST NAME:FIRST"
1940 PRINT "NAME MI.(XXXXX;XXXXX X.) PLACE A '*' IMMEDIATELY"
1950 PRINT "AFTER NAME IF PERSON IS ON YOUR XMAS CARD LIST"
1960 PRINT : PRINT "TYPE '9' IF THERE ARE NO MORE NAMES"
1970 PRINT "TO BE ADDED TO YOUR LIST"
1980 PRINT :INPUT "NAME ",N$(L)
1990 IF N$(L)=U$ THEN I=100:GOTO 370
2000 PRINT :PRINT CHR$(16);CHR$(22)
2010 PRINT "TYPE STREET ADDRESS--PATTERN NOT IMPORTANT"
2020 PRINT :INPUT "STREET ",A$(L)
2030 PRINT :PRINT CHR$(16);CHR$(22)
2040 PRINT "TYPE CITY: STATE AND ZIP CODE"
2050 PRINT "USING THIS PATTERN: XXXXX;XX.XXXXX"
2060 PRINT :INPUT "CITY: STATE & ZIP ",C$(L)
2070 PRINT : PRINT CHR$(16);CHR$(22)
2080 PRINT "TYPE PHONE NUMBER--PATTERN NOT IMPORTANT"
2090 PRINT "IF PHONE NUMBER IS UNKNOWN, HIT 'RETURN' KEY"
2100 PRINT :INPUT "PHONE NUMBER ",P$(L)
2110 PRINT :PRINT CHR$(16);CHR$(22)
2120 PRINT "TYPE BIRTHDATE. USE MONTH-DAY-YEAR PATTERN:"
2130 PRINT "XX-XX-XX. IF BIRTHDATE IS NOT KNOWN, TYPE 00-00-00"
2140 PRINT :INPUT "BIRTHDATE ",B$(L)
2210 NEXT L
2350 REM * * * SUBROUTINE--HARD COPY * * *
2355 IF N=1 THEN 2400
2360 PRINT :PRINT "TURN TELEPRINTER 'ON'":PRINT
2370 PRINT "WHEN TELEPRINTER IS READY, PRESS 'RETURN' KEY"
2380 PRINT : INPUT "READY ",W$
2390  N=1
2400 PRINT #3,P;TAB(5);N$(P);TAB(35);A$(P)
2410 PRINT #3,TAB(5);C$(P);TAB(35);P$(P)
2420 PRINT #3,TAB(5);B$(P);TAB(35);"AGE IS ";F$
2440 RETURN
2500 PRINT CHR$(16);CHR$(22);TAB(14);"INPUT FROM TAPE":PRINT
2510 PRINT "PREPARE RECORDER FOR INPUT OF ADDRESS LIST TAPE"
2520 PRINT : PRINT"--------SET BAUD RATE SWITCHES--------"
2530 PRINT :PRINT"WHEN ALL IS READY, PRESS 'RETURN' KEY"
2540 PRINT : INPUT "READY ",H$
2550 PRINT CHR$(17): U=1
2560 FOR I= 1 TO R
2570 INPUT N$(I)
2580 IF N$(I)=U$ THEN 2850
2590 INPUT A$(I)
2600 INPUT C$(I)
2610 INPUT P$(I)
2620 INPUT B$(I)
2630 NEXT I
2650 PRINT CHR$(19)
2670 ON S GOTO 540,720,910,1050,1170
2680  F$=X$
2690 GOTO 1480
2720 GOTO 2650
2730 REM * * * PRINT-OUT OPTION * * *
2740 PRINT CHR$(16); CHR$(22)
2750 PRINT "TYPE ONE OF THE FOLLOWING NUMBERS TO INDICATE HOW"
2760 PRINT "YOU WISH TO PRESENT ADDRESS LIST INFORMATION."
2770 PRINT :PRINT TAB(5);"1--DISPLAY ON CRT MONITOR"
2780 PRINT :PRINT TAB(5);"2--DISPLAY ON TELEPRINTER"
2790 PRINT : INPUT "INSTRUCTION NUMBER ",E
2800 RETURN
2810 REM * * * SUBROUTINE--PRINTOUT * * *
2820 IF E=1 GOSUB 1600
2830 IF E=2 GOSUB 2350
2840 RETURN
2850  U=2
2860 GOTO 2650
2870 REM * * * SUBROUTINE--CONTINUE * * *
2880 PRINT : PRINT "TO CONTINUE, PRESS 'RETURN' KEY"
2890 INPUT J$: PRINT CHR$(16);CHR$(22)
2900 RETURN
9999 END
```

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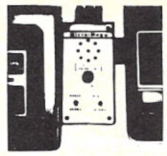

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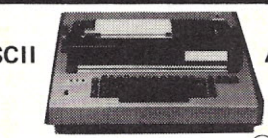
ASCII  ASCII

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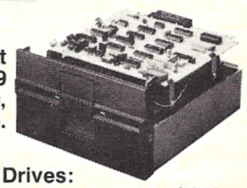

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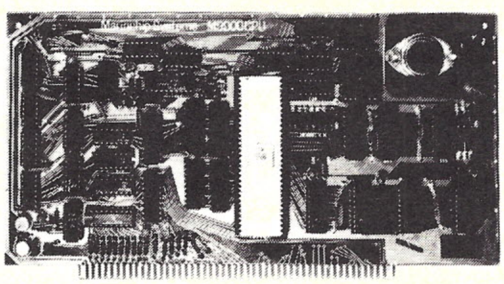

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Ready for the Nuthouse?

Actually, it's a random-message generator with delightful possibilities!

Here is a program called Cookie. Each time you run it, you get out a different one-line message, which may be silly or profound. The messages are stored in the program as DATA statements . . . two DATA statements per message. Any number of messages, within the limits of memory, can be stored; three sample messages are shown in the program listing.

When the program starts, it runs through the list of messages to count how many there are (for this reason line 9999 has to remain at the end to act as a last message indicator). Then it uses the number it detects to set up the random-number generator in step 70 so that it will run through the complete list of messages without ever giving the same message twice in a row. The more messages there are, the more randomly they come out.

In case you are wondering why it is called Cookie—isn't it just like a Chinese fortune cookie?■

```
0010 FOR I=1 TO 1000
0020 READ M$
0030 IF M$="LAST" GOTO 50
0040 NEXT I
0050  NO = (I-1)/2
0060 RESTORE
0070  D=INT(RND(0)*NO)
0080 FOR I=1 TO D
0090 READ M$, N$
0100 IF M$<>"LAST" GO TO 130
0110 RESTORE
0120 READ M$, N$
0130 NEXT I
0140 PRINT M$; " "; N$
0150 INPUT M$
0160 IF M$ = "STOP" THEN END
0170 GOTO 70
0130 DATA "IN CASE OF FIRE, KEEP CALM,"
0190 DATA "PAY BILL, RUN LIKE HELL."
0200 DATA "NOT GOOD IDEA TO KILL 2 BIRDS"
0210 DATA "WITH 1 STONE IN GLASS HOUSE."
0220 DATA "YOU WILL FALL IN LOVE WITH A"
0230 DATA "ROM MONITOR"
9999 DATA "LAST", "MESSAGE"

READY
#RUN
NOT GOOD IDEA TO KILL 2 BIRDS WITH 1 STONE IN GLASS HOUSE.
?
YOU WILL FALL IN LOVE WITH A ROM MONITOR
?
IN CASE OF FIRE, KEEP CALM, PAY BILL, RUN LIKE HELL.
?
YOU WILL FALL IN LOVE WITH A ROM MONITOR
?
```

Program listing.

Philip Ngai
362 Memorial Dr.
Cambridge MA 02139

Build a One-Chip Single Stepper

Try this fine debugging aid for home-brew 6502 systems.

The 6502 is a great chip. All you KIM owners know what I mean. But, suppose you don't want to go with the KIM; you want to design your own system, then you may want to single-cycle the microprocessor.

Why? Should your design not work the first time you turn it on (it does happen to us mere mortals), you'll have to debug it. One time-honored method is to start in a known-good state, and then allow the CPU to proceed one step at a time. Watch the lines you think are misbehaving, and when the CPU first fails to do what you expect, stop and find out why. Proceed like this until everything works as it should (with any luck this won't take too long since the 6502 was designed to be easy to use).

Resetting will get you to a known-good state. Now you need to single-step. The 6502 can be stopped by pulling the RDY line low. Thus, single-stepping is done by allowing the RDY line to go high for one clock period. MOS Technology offers a circuit capable of doing this; however, the chip count is enough to make you think twice about building it.

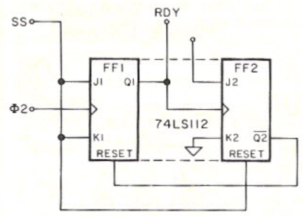

Fig. 1. When SS makes a low-to-high transition, the 6502 will perform one cycle. Phase 2 is from pin 39 of the 6502.

My circuit takes only one chip, assuming you have a debounced single-step (SS) signal available. Look at the circuit in Fig. 1 while following the description below. Assume you start with Q1 and SS low. Then, since J1 and K1 are both low, Q1 will not change. Now let SS go high. When Phase 2 comes along, Q1 goes high. The next time Phase 2 comes along Q1 goes low, clocking FF2.

$\overline{Q}2$, which was high because it had been reset by SS, now goes low because FF2 has been clocked. This keeps Q1 low. When SS goes low, no further changes occur because J1 and K1 are now low and the cycle is complete.

Remember, the 6502 does not stop in a write cycle. This had me puzzled for a while. (Moral: Always read the directions!) ■

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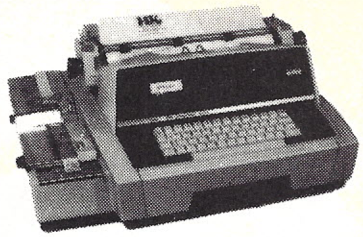

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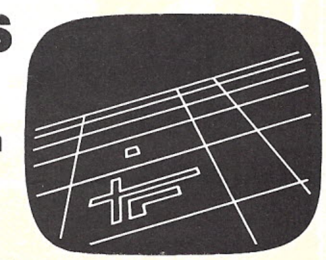

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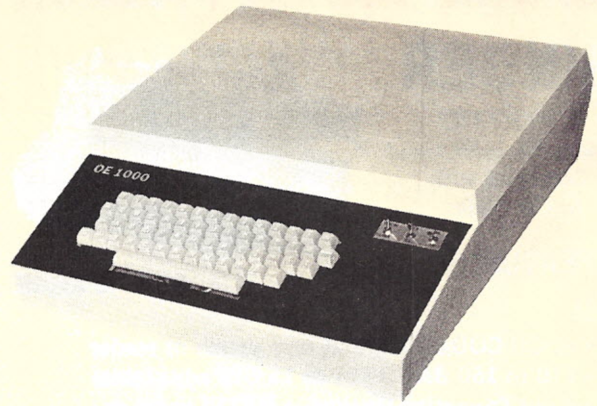

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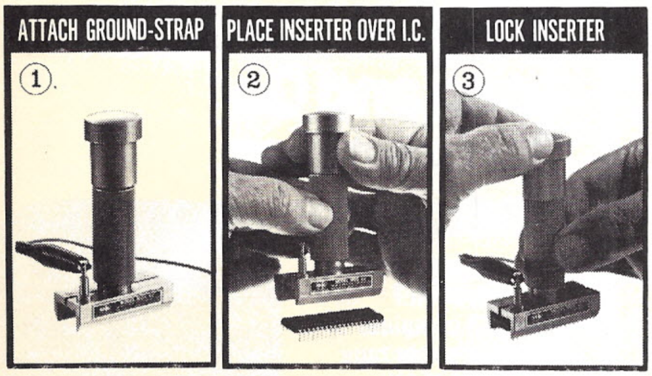

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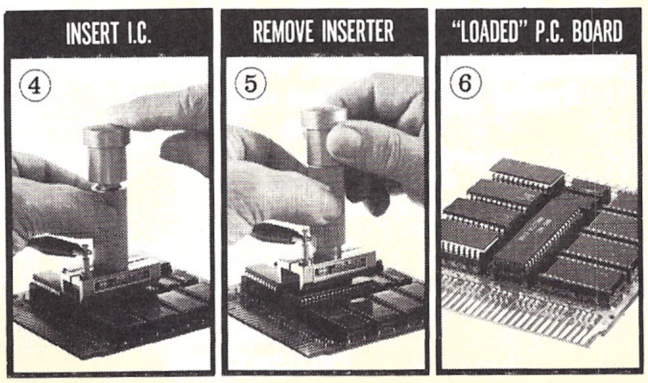

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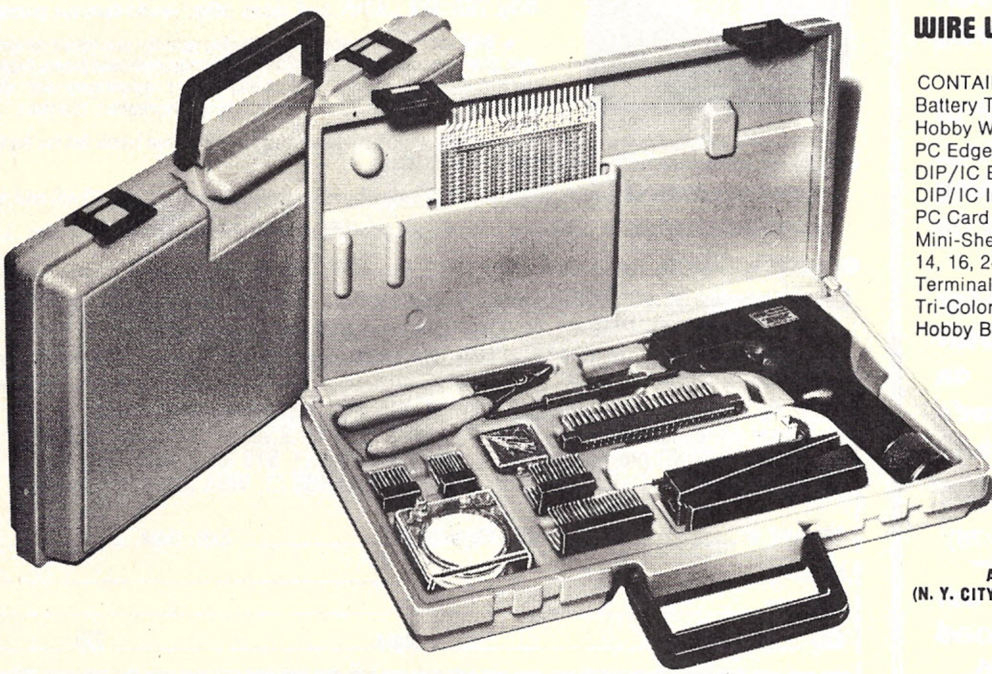

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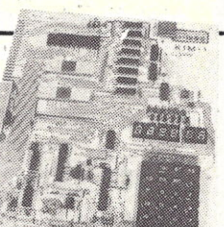

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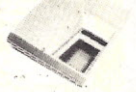

Give your KIM a professional appearance. No alterations required, sturdy Kydex 100. Black
Cat. No. EGI-ENC-SKEII **$23.50**

EXIDY SORCERER $895

- Z-80 Processor
- Full-size ASCII keyboard
- User definable characters
- Up to 32K on-board RAM
- Interchangeable ROM PACs
- 30 x 64 display
- Resident 4K Monitor ROM
- Dual Cassette I/O
- Serial and Parallel I/O
- Complete Operators Manual
- Only $895

State-of-the-art technology makes these features available at a fantastic price. You simply add a monitor and tape decks to complete the system. Control key enables you to use it as a terminal. Later ROM PACs will give you Z-80 Assembly Language, APL, PILOT, Word Processing and a DOS PAC for FORTRAN and COBOL. What a system for only $895!

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Reduce fuel costs — monitor your engines' performance in real time **$129.50**

The AUTOCOMP mounts in or on your dash, and by pushbutton control provides LED readouts of the following driving functions: Instantaneous MPG, Average MPF, Fuel Used, Distance Traveled, and Correct Time.

*AUTOCOMP can be installed on most American and Japanese make autos and vans except those with fuel injection and is NOT recommended for European imports.

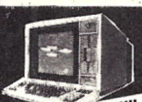
Rockwell AIM65

NEW!

- Fully assembled, tested, and warranteed
- Addressing to 65K bytes (1K RAM on board)
- Includes onboard
  - Powerful 4K ROM Debug/Monitor
  - Sockets for additional 4K RAM 16K ROM
  - 20 Col. ASCII Thermal printer (90 lines/min.)
  - Full size (54 key) Alphanumeric keyboard
  - 20 char ASCII Alphanumeric display
  - Application Conn. for TTY, 2 cassettes, 2 8 big I/O ports
  - Expansion Conn. (try our KIMSI S-100 board)
  - Both connectors totally KIM-1 compatible
- Easy Power connections

Options — 4K ROM Assembler/Text Editor
8K Basic ROM $375

Compucolor II

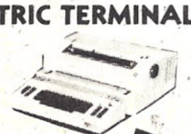


NEW!

Disk-based Model 3
$1,495

- Beautiful color graphics
- 16K ROM with Extended Disk BASIC
- Editing and file control commands
- 8K Graphics, 4K User RAM
- Integral Mini-floppy holds 51.2K bytes
- RS-232 Asynch. I/O
- Full-size keyboard
- Popular 8080 microprocessor
- Variety of pre-programmed diskettes available

TC-71 SELECTRIC TERMINALS



Based upon the heavy duty selectric mechanism. RS232, PTTC code. See catalog for details and easy interfacing information. Specify table top or version with its own desk.

Refurbished	$695
Cleaned & working	$495
AS IS	$339
Documentation	$30

SALE!

SALE **ASCII INTERFACE FOR TC-71**
30 day delivery Normally $199 **NOW $169**

Digicom Acoustic Coupler for use with ASCII TC-71 **$225**

Table-top Datel/Selectric Terminals

- High quality printing
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- Local, remote or wait status selection
- Computer controllable terminal functions
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- Interrupt and reverse break
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- Portability
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- Interface: RS232C (BCD code)

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Single board VIDEO TERMINAL

SALE!

16 Ln x 64 chr display, 128 printable characters, software UART (ASCII or Baudot), 3 serial interfaces + cassette I/O, true composite video, ASCII keyboard (parallel input) TTL compatible, easy power connection.

Assembled & tested **NOW $187**

GRI ASCII KEYBOARD

53 keys in standard ASR-33 layout:

Kit	$59.95
Assembled	$71.95
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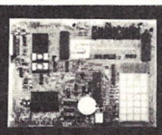
VIM-1 From Synertek



NEW!

- 28 Double-function keypad including up to 24 "Special" functions
- Easy-to-view 6-digit hex led display
- KIM-1 hardware compatibility
- 6502 based system
- 4K byte ROM resident monitor and operating system
- Single 5 volt power
- 1K bytes of 2114 static RAM on sockets provided for immediate expansion to 4K bytes
- Enhanced software
- Standard interfaces include:
  - Audio Cassette Recorder Interface with Remote Control
  - Full Duplex 20mA Teletype Interface
  - System Expansion Bus Interface
  - TV Controller Board Interface
  - CRT Compatible Interface
- 50 I/O Lines in the basic system

$269.00

SANYO MONITOR

VM4209 9 quality monitor **$149**

Books

DESCRIPTION	PRICE
Telephone Accessories You Can Build	4.95
The First Book of KIM (New Edition)	9.00
Basic BASIC: An Introduction	7.95
Advanced BASIC: Application and Solutions	6.95
Home Computers: A Beginners Guide	6.95
THE ADAM OSBORNE SERIES:	
An Introduction to Microcomputers V. 0	7.50
An Introduction to Microcomputers V. I	7.50
An Introduction to Microcomputers V. II	15.00
8080 Prog. for Logic Design	7.50
6800 Prog. for Logic Design	6.95
Some Common BASIC Programs	7.50
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PET String and Array Handling	3.95
PET Graphics	4.95
PET Cassette I/O	4.95
Miscellaneous PET Features	3.95
PET LITERATURE PACKAGE	
A collection of three valuable publications relating to the PET 2001.	
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Dot matrix impact, 30 or 10 cps, prints full (94 chr.) ASCII set.
Sprocket feed, TTL interface **$1,143**
Sprocket feed, EIA interface **$1,377**

New Acoustic Coupler $159 Assembled

NCE/Compumart Inc. breaks the price barrier with a new 300 baud RS-232C acoustic coupler. For only $159 you get an assembled, tested stand alone unit which accepts the standard telephone handset for full or half duplex operation. Complete with power supply and carrier detect light, the unit is housed in an attractive case for desk top use.

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24 Ln. x 80 chr. display:

Kit Reg. $795 **NOW $755**
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Lower case option **$50**

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Surface area: 8½ x 11 inches
Plot Area: 7 x 10 inches
200 or 100 increments per inch; 240 steps per second at .01 inch or 480 steps per second at .005. EIA RS-232C (Serial). 6-Line, TTL. (Parallel) **$1,085**

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RS232C or parallel interface, full upper & lower case ASCII, 8½ paper, baud rates to 1200, 80 columns, built in self-test.

NOW only $749/when purchased with COMPUCOLOR II, PET, VIM, KIM OR AIM

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ALT-2480 24LN x 80CH display **$295**
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SALE!

Hexadecimal, octal, decimal calculator/converter.

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DUAL TRACE 15 MEGAHERTZ PORTABLE MINISCOPE

$435.00

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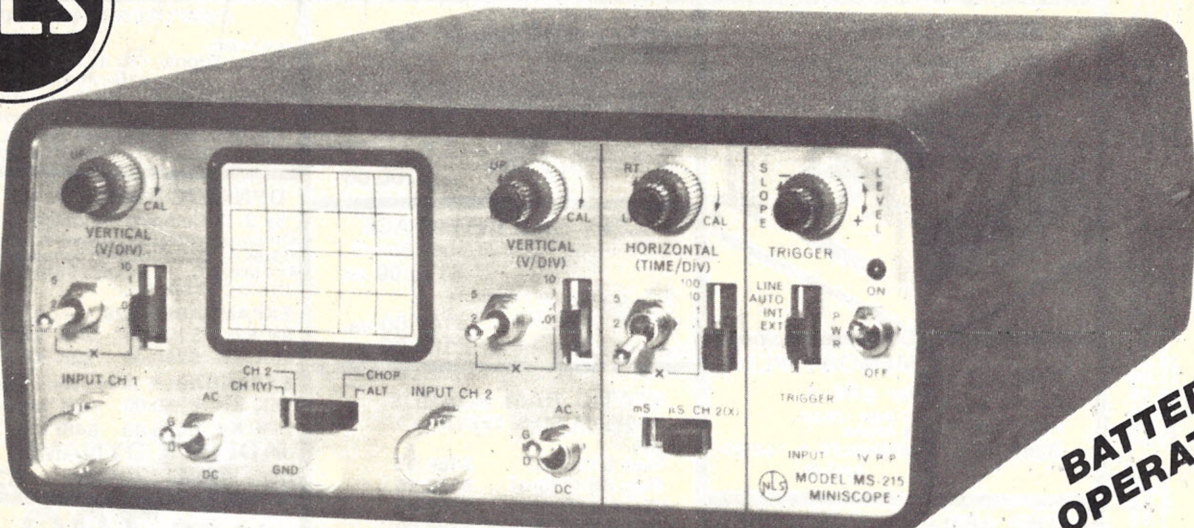

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BATTERY OPERATED!

FEATURES

- Dual Trace- 2 channel: separate, chopped or alternate modes.
- 15 megahertz bandwidth.
- External and internal trigger.
- Time Base - 0.1 microseconds to 0.5 Sec/div - 21 settings.
- Battery or line operation.
- Automatic and line sync modes.
- Power consumption less than 15W.
- Verticle Gain - 0.01 to 50 volts/div —12 settings.
- Weight is only 3 pounds.

From the originator of the Digital Voltmeter, Non-Linear Systems comes the MS-215 Miniscope. It is a fine electronic instrument with a great deal of measuring capability and excellent accuracy. Its design is modern, utilizing the latest in low-powered integrated circuits, and it is packaged into the smallest practical size. The instrument fits into many briefcases and tool boxes with room to spare.

Operating characteristics have been chosen so that the MS-215 will make all of the measurements needed in servicing most electronic equipment. It is field-portable so its use is not restricted to the bench.

SPECIFICATIONS:

Vertical

Mode: CH1, CH2, CH1 & CH2 (Chopped) & CH1 & CH2 (Alt.)
The Following Specifications apply to each channel

Y Axis

Verticle Input: 10mV/div to 50V in 12 Calibrated ranges, as follows:
x1-10mV/div to 10V/div in four ranges, each continuously variable.
x2-20mV/div to 20mV/div in four ranges, each continuously variable.
x5-50mV/div to 50mV/div in four ranges, each continuously vairiable.
Accuracy is 3%

Input Impedence: 1M ohm shunted by 50 pF.

Bandwidth: DC/DC to 15 Mhz ±6 db (DC to 8 Mhz ±3 db). AC, same as DC down to 3Hz.

Rise Time: Approximately 23 nS @ 1 division deflection.

Input Voltage: 250 maximum (DC and Peak AC).

Horizontal

Mode: Internal Time Base or External Horizontal, switch selectable. In the XY mode, vertical input is through CH1 and horizontal input is through CH2

Bandwidth: DC to 200 KHz (±3 db).

Coupling: AC, DC or ground, switch selectable. Low frequency point on AC is 3 Hz.

Input Impedence: 1Meg ohm shunted by 50 pF.

Deflection Factor: 10mV/div to 50V/div in 12 calibrated ranges. The ranges can be calibrated with the CH2 gain control

Input Voltage: 250V maximum (DC and Peak AC)

Time Base: **0.1uS/div to 0.5 Sec/div in 21' calibrated ranges, as follows:**
x1, uS-0.1uS/div to 100 uS/div. x2, uS-0.2uS/div to 200 uS/div.
x5, uS-0.5uS/div to 500 uS/div. x1, mS-0.1mS/div to 100 mS/div
x2, mS-0.2mS/div to 200 mS/div. x5, mS-0.5mS/div to 500 mS/div.
all in four ranges, each continuously variable. (Range increments ar .1, 1, 10, 100.) With vernier in full clockwise position, calibrated time measurements are possible. Accuracy is 3%.

Triggering

Internal: Sweep triggered from internal trigger source (In the dual trace modes, the internal trigger source is CH1).

Automatic: Trigger source is internal calibrater frequency. To be used if there is no other trigger source available to synchronize the sweep.

Line: Trigger is derived from line frequency when using the battery charger.

External: Controls function as for internal triggering (1 Megohm input impedence).

Slope: Selects sync to positive- or negative- going waveform.

Coupling: AC

Sensitivity: Less than 1 div for internal trigger and less than 1 volt for external trigger.

Level: Trigger Level control permits continuous adjustment of trigger point in all modes except Auto.

Internal Calibrater: A square-wave signal of 1 volt p-p ± 5% is provided. Frequency is approximately 1KHz.

Display

Graticule: 4x5 div, each division is 0.25 inch. Viewing area 1.1"Hx1.35"W

CRT: Bluish-white phospher, medium peristence. CRT uses low power filament for low battery drain. Instant on!

Power

On-Board Batteries: Three sealed, rechargeable lead acid "D" Cells

Operating Time: Typically 4 hours.

Charging Time Scope Operating: Will run indefinitely but not reach full charge.

Non-operating: Sixteen hours.

External Power: Battery charger 115 vac (220 vac on request). 50-400Hz, less than 15 watts.

Dimensions: 3.1"Hx6.4"Wx8.0"D.

Weight: Three pounds.

Environment

Operating Temperature: 0° to 40° C

Shock and Vibration: Designed to with stand normal shock and vibration encountered in commercial shipping and handling.

Accessories

Furnished: Tilt stand, battery charger, 2 input cables, and 3 miniature banana plugs.

Optional: Leather carrying case and probes

Warranty: One year parts and labor. Made in the U.S.A

MS-215 with Rechargeable Batteries and Charger $395.00

Leather Carrying Case

The leather case has 2 separate compartments. One to hold the scope, the other to hold the charger, probe, shoulder strap, etc. The case can be worn on the belt, or over the neck.

The snaps used on the case are "one way", thus accidental striking of the case against an object will not undo the snaps or let it be pulled off your belt.

41-140 **$45.00**

Probes

10 to 1 probe with 10 megohm input.

Probe uses spring hook tip for sure connection. Compensation network is located at the connector rather than at the probe, so as to keep size and weight to a minimum.

41-141 **$27.00**

Deluxe Combination Probe

Switchable 10to1/1to1 probe with an assortment of probe tips to suit any situation.

41-3495 **$36.00**

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P21

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21L02 (350ns) Static Rams 120 @ $1.00 ea.	1702A E-PROM $4.75 ea.	6502 Microprocessor 5 @ $11.00 ea.	2708 (450ns) E-PROM 8 @ $7.50 ea.	21L02 (250ns) Static Rams 100 @ $1.25 ea.	Z-80A Microprocessor 5 @ $25.00 ea.
Z-80 Microprocessor 5 @ $20.00 ea.	MM5257 lo pw repl. TMS4044 8 for $8.00 ea.	2114L (250ns) 8 for $8.25 ea.	TMS 4044 (250ns) 16 @ $8.00 ea.	4200A (200ns) Static Rams 25 @ $10.00 ea.	4116 (200ns) 16K Dyn. Ram 8 @ $20.00 ea.

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2716 (INTEL)	50.00
2758	26.60

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21L02 (450ns)	1.50	1.18
21L02 (250ns)	1.75	1.50
410D	10.00	8.50
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2111-1	3.25	2.65
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2114 (450ns)	9.00	7.69
2125L	11.00	8.30
TMS4044 (250ns)	8.95	8.00
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FLOPPY DISC CHIPS

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8" FLOPPY DISC DRIVE.
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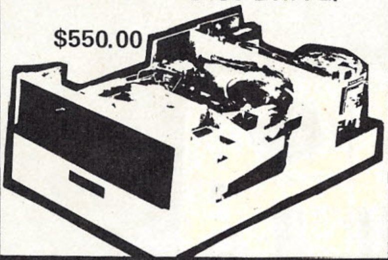

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One of the best "Total Package" home and business computers on the market. "Basic" in ROM, Color Graphics, Floating Point Basic Package, etc.

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Dynamic Ram Chip can be used for expanding Apple II Memory or the TRS-80 (200ns)

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9 slot "Little Mother"	$35.00
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Bare board	$35.00
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44 Pin - PC & EYE	$1.95
44 Pin - WW	$2.50
86 Pin - (6800) PC	$5.00
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MODEL 801R Shugart Disc with Cabinet
Includes Cabinet, Disc Drive, Power Supply, Cable, Fan & Data Cable. Has AC line filter.
Cabinet size 10"H x 10"W x 16"D
MODEL DM 2700-S **$750.00**

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ASSEMBLED & TESTED
8K

Ram 8 (250ns)	$169.95
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Ram 16 (250ns)	$375.00
Ram 16B (450ns)	$325.00
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32K Assembled & Tested by SEALS ELECTRONICS

JG-32 (250ns)	$795.00
JG-32B (450ns)	$725.00
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6800 Adapter - adapts Mem-1 8K board to Motorola MEK 6800D2 evaluation kit.

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with memory management can be used with Alpha Micro or Cromenco Systems. ASSEMBLED & TESTED

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EXPANDABLE E-PROM – S.D. Computer Products
16K or 32K EPROM $49.95 without EPROM
Allows you to use either 2708's for 16K of Eprom or 2716's for 32K of EPROM.

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Includes: **$295.00**
Power Supply +8v at 18amps
±16v at 2 amps
Mother Board - 12 slots with connectors Assembled & Tested
Has Whisper Quiet Fan & AC Line Filter
Cabinet size 7"H x 19"W x 22" D

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by S. D. Computer Products
On board refresh is provided with no wait states or cycle stealing required. +8 VDC 400MA DC, +18 VDC 400MA and -18 VDC 30MA DC.

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16K Kit $240.00 32K Kit $400.00

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16K Kit $250.00 48K Kit $675.00
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uses 4096 (300ns) **$200.00**

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with PROVISIONS for ONBOARD 2708 and POWER ON JUMP

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Assembled & Tested **$139.95**

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32 or 64 Characters per line - 16 lines
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Powerful software included for cursor, home, EOL, Scroll Graphics/Character Upper case, lower case and Greek. Black-on-white & White-on-black.

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- 1 parallel port.

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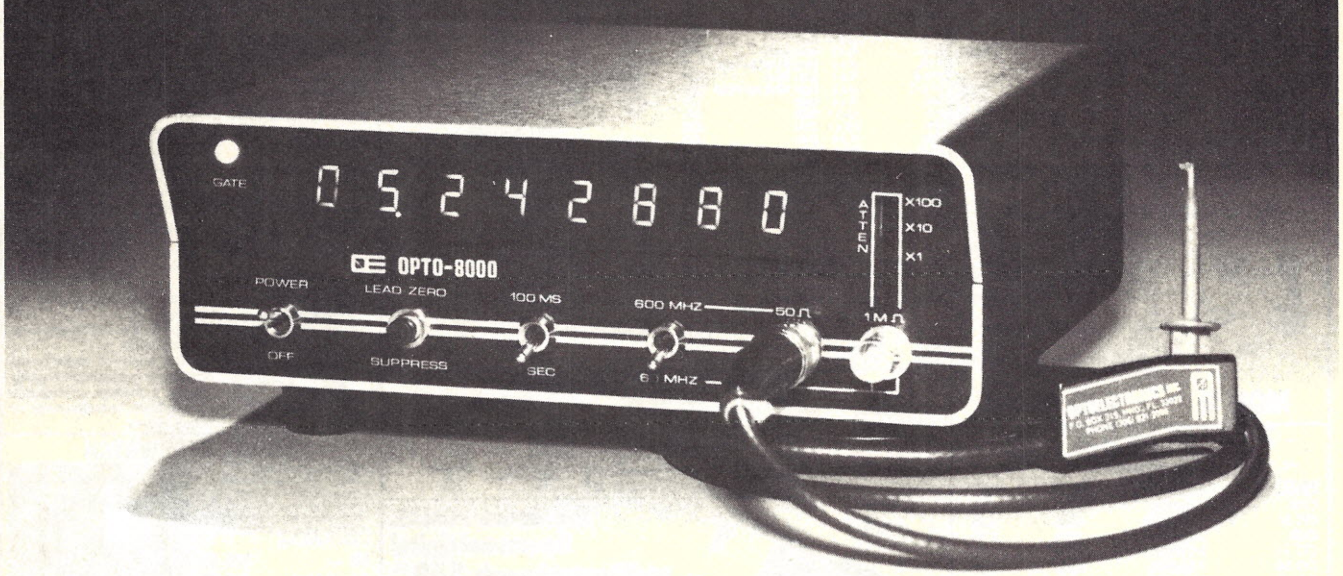
OPTO-8000.1



This new instrument has taken a giant step in front of the multitude of counters now available. The Opto-8000.1 boasts a combination of features and specifications not found in units costing several times its price. Accuracy of ±0.1 PPM or better — *Guaranteed* — with a factory-adjusted, sealed TCXO (Temperature Compensated Xtal Oscillator). **Even kits require no adjustment for guaranteed accuracy!** Built-in, selectable-step attenuator, rugged and attractive, black anodized aluminum case (.090″ thick aluminum) with tilt bail. 50 Ohm and 1 Megohm inputs, both with amplifier circuits for super sensitivity and both diode/overload protected. Front panel includes "Lead Zero Blanking Control" and a gate period indicator LED. AC and DC power cords with plugs included.

SPECIFICATIONS:
Time Base—TCXO ±0.1 PPM GUARANTEED!
Frequency Range—10 Hz to 600 MHz
Resolution—1 Hz to 60 MHz; 10 Hz to 600 MHz
Decimal Point—Automatic
All IC's socketed (kits and factory-wired)
Display—8 digit LED
Gate Times—1 second and 1/10 second
Selectable Input Attenuation—X1, X10, X100
Input Connectors Type —BNC
Approximate Size—3″h x 7½″w x 6½″d
Approximate Weight—2½ pounds
Cabinet—black anodized aluminum (.090″ thickness)
Input Power—9-15 VDC, 115 VAC 50/60 Hz
or internal batteries

OPTO-8000.1 Factory Wired	**$299.95**
OPTO-8000.1K Kit	**$249.95**

ACCESSORIES:

Battery-Pack Option—Internal Ni-Cad Batteries and charging unit	**$19.95**
Probes: P-100—DC Probe, may also be used with scope	**$13.95**
P-101—LO-Pass Probe, very useful at audio frequencies	**$16.95**
P-102—High Impedence Probe, ideal general purpose usage	**$16.95**
VHF RF Pick-Up Antenna-Rubber Duck w/BNC #Duck-4H	**$12.50**
Right Angle BNC adapter #RA-BNC	**$ 2.95**

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Owners of FC-50 counters with #PSL-650 Prescaler can use this kit to convert their units to the Opto-8000 style case, including most of the features.

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*FC-50 — Opto-8000F	**Factory Update $99.95**
FC-50 — Opto-8000.1 (w/TCXO)	**Kit $109.95**
*FC-50 — Opto-8000.1F	**Factory Update $149.95**

*Units returned for factory update must be completely assembled and operational

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SN7412N	.25	SN7489N	1.75	SN74175N	.79
SN7413N	.40	SN7490N	.45	SN74176N	.79
SN7414N	.70	SN7491N	.59	SN74177N	.79
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SN7420N	.20	SN7494N	.65	SN74181N	1.95
SN7421N	.29	SN7495N	.65	SN74182N	.79
SN7422N	.39	SN7496N	.65	SN74184N	1.95
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SN7432N	.25	SN74122N	.39	SN74193N	.79
SN7437N	.25	SN74123N	.49	SN74194N	.89
SN7438N	.25	SN74125N	.49	SN74195N	.69
SN7439N	.25	SN74126N	.49	SN74196N	.89
SN7440N	.20	SN74132N	.75	SN74197N	.89
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74C08	.75	74C95	2.00	74C192	3.49
74C10	.65	74C107	1.25	74C193	2.75
74C14	3.00	74C151	2.90	74C195	2.75
74C20	.65	74C154	3.00	74C922	9.95
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74LS01	.23	74LS54	.23	74LS151	.69
74LS02	.23	74LS55	.23	74LS155	.69
74LS03	.23	74LS73	.35	74LS157	.69
74LS04	.29	74LS74	.35	74LS160	.89
74LS05	.29	74LS75	.49	74LS161	.89
74LS08	.23	74LS76	.35	74LS162	.89
74LS09	.29	74LS83	.75	74LS163	.89
74LS10	.23	74LS85	.99	74LS164	.99
74LS13	.49	74LS86	.35	74LS175	.79
74LS14	.99	74LS90	.49	74LS181	2.49
74LS15	.29	74LS92	.59	74LS190	.89
74LS20	.23	74LS93	.59	74LS191	.89
74LS21	.29	74LS95	.79	74LS192	.89
74LS22	.29	74LS96	.89	74LS193	.89
74LS26	.29	74LS107	.35	74LS194	.89
74LS27	.29	74LS109	.35	74LS195	.89
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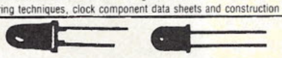

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MAN 74	Common Cathode-red	.300	1.25	DL701	Common Anode-red ±1	.300	.99
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MAN 82	Common Anode-yellow	.300	.99	DL704	Common Cathode-red	.300	.99
MAN 84	Common Cathode-yellow	.300	.99	DL707	Common Anode-red	.300	.99
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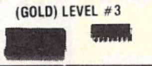

8 pin WW	$.40	.38	.35	22 pin WW	$ .95	.85	.75
10 pin WW	.45	.41	.37	24 pin WW	1.05	.95	.85
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		68 OHM	82 OHM	100 OHM	120 OHM	150 OHM		
ASST. 2	5 ea.	180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	1/4 WATT 5%	50 PCS.
		470 OHM	560 OHM	680 OHM	820 OHM	1K		
ASST. 3	5 ea.	1.2K	1.5K	1.8K	2.2K	2.7K	1/4 WATT 5%	50 PCS.
		3.3K	3.9K	4.7K	5.6K	6.8K		
ASST. 4	5 ea.	8.2K	10K	12K	15K	18K	1/4 WATT 5%	50 PCS.
		22K	27K	33K	39K	47K		
ASST. 5	5 ea.	56K	68K	82K	100K	120K	1/4 WATT 5%	50 PCS.
		150K	180K	220K	270K	330K		
ASST. 6	5 ea.	390K	470K	560K	680K	820K	1/4 WATT 5%	50 PCS.
		1M	1.2M	1.5M	1.8M	2.2M		
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NEW NAME

Jameco ELECTRONICS

a division of JAMES ELECTRONICS of California

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS – WORLDWIDE
1021 HOWARD AVENUE, SAN CARLOS, CA 94070
Advertised Prices Good thru October

J1

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire.

$12.95

WIRE WRAP TOOL WSU-30
WRAP • STRIP • UNWRAP -$6.95

WIRE WRAP WIRE — 30 AWG

25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30

- 50 ft. roll 30 AWG KYNAR wire wrap wire **$3.95 ea.**
- Cuts wire to desired length
- Strips 1" of insulation **Specify** — Blue-Yellow-White-Red

REPLACEMENT DISPENSER SPOOLS FOR WD 30
Specify blue, yellow, white or red **$1.98/spool**

XR2206KA $14.95
Function Generator Kit (includes chip, P.C. Board and instructions)

EXAR

XR2206KB $19.95
Function Generator Kit (includes all components, P.C. Board and instructions)

XR-L555 $1.50
Micro-Power version of the popular 555 Timer and directly interchangeable. Dissipates 1/15th the power and operates down to 2.7 volts. Perfect for battery operation and CMOS circuits.

XR2242CP $1.50
Precision timing circuit for generating timing pulses in **minutes, hours** and days or up to 1 year by using two. Reduces cost of time delay circuits. Basic 555 Timer with built-in 8-bit Counter.

XR205	$ 8.40			XR2556	$ 3.20
XR210	4.40	XR1489	1.39	XR2567	2.99
XR215	4.40	XR1800	3.20	XR3403	1.25
XR320	1.55	XR2206	4.40	XR4136	1.25
XR555	.39	XR2207	3.85	XR4151	2.85
XR556	.99	XR2208	5.20	XR4194	1.45
XR567CP	.99	XR2209	1.75	XR4202	3.60
XR567CT	1.25	XR2211	5.25	XR4212	2.05
XR1310P	1.30	XR2212	4.35	XR4558	.75
XR1468CN	3.85	XR2240	3.45	XR4739	1.15
XR1488	1.39	XR2264	4.25	XR4741	1.47

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	4/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25m	20/1.00
1N5232	5.6	500m	28	1N4734	5.6	1w	28
1N5234	6.2	500m	28	1N4735	6.2	1w	28
1N5235	6.8	500m	28	1N4736	6.8	1w	28
1N5236	7.5	500m	28	1N4738	8.2	1w	28
1N456	25	40m	6/1.00	1N4742	12	1w	28
1N458	150	7m	6/1.00	1N4744	15	1w	28
1N485A	180	10m	5/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.70
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C38M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
TIS133	5/1.00	PN3567	3/1.00	PN4249	4/1.00
TIS135	5/1.00	PN3568	4/1.00	PN4250	4/1.00
40409	1.75	PN3569	4/1.00	2N4400	4/1.00
40410	1.75	MPS3638A	5/1.00	2N4401	4/1.00
40673	1.75	MPS3702	5/1.00	2N4402	4/1.00
2N918	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2219A	3/1.00	MPS3704	5/1.00	2N4409	5/1.00
2N2221A	4/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2222A	5/1.00	MPS3705	5/1.00	2N5087	4/1.00
2N2369	5/1.00	2N3706	5/1.00	2N5088	4/1.00
2N2369A	4/1.00	MPS3706	5/1.00	2N5089	4/1.00
MPS2369	5/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2484	4/1.00	2N3711	5/1.00	PN5134	5/1.00
2N2906	4/1.00	2N3724A	.65	PN5138	5/1.00
2N2907	5/1.00	2N3725A	1.00	2N5139	5/1.00
2N2925	5/1.00	2N3772	2.25	2N5210	5/1.00
MJE2955	1.25	2N3823	1.00	2N5449	3/1.00
2N3053	2/1.00	2N3903	4/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075
100 VOLT MYLAR FILM CAPACITORS							
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22
+20% DIPPED TANTALUMS (SOLID) CAPACITORS							
.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS							
Axial Lead				**Radial Lead**			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

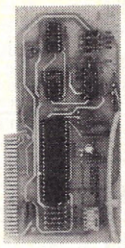
S A V E

COMPUTER INTERFACES & PERIPHERALS

S A V E

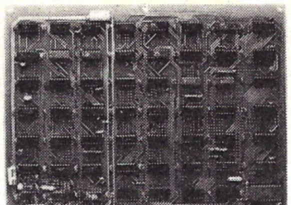
For free catalog including parts lists and schematics, send a self-addressed stamped envelope.

APPLE II SERIAL I/O INTERFACE *



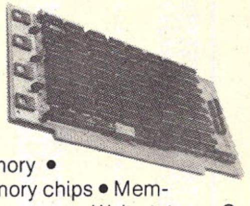
Part no. 2
Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer. • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. Board only — $15.00; with parts — $42.00; assembled and tested — $62.00.

T.V. TYPEWRITER



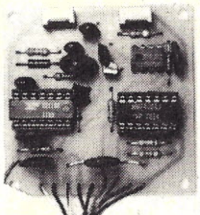
Part no. 106
• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled curser • Auto scroll • Non-destructive curser • Curser inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only $39.00; with parts $145.00

8K STATIC RAM



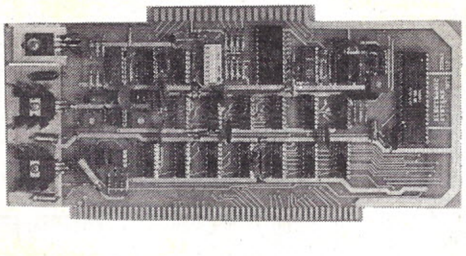
Part no. 300
• 8K Altair bus memory • Uses 2102 Static memory chips • Memory protect • Gold contacts • Wait states • On board regulator • S-100 bus compatible • Vector input option • TRI state buffered • Board only $22.50; with parts $160.00

MODEM *



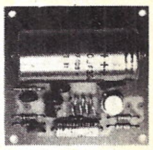
Part no. 109
• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 ohm speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board $7.60; with parts $27.50

TIDMA *



Part no. 112
• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate. • S-100 bus compatible • Board only $35.00; with parts $110.00

RF MODULATOR *

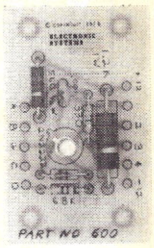


Part no. 107
• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple. • Power required is 12 volts AC C.T., or +5 volts DC • Board $7.60; with parts $13.50

DC POWER SUPPLY *

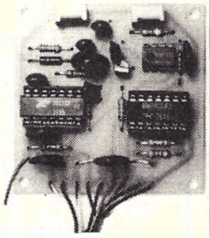
Part no. 6085
• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50; with parts excluding transformers $42.50

RS 232/TTY * INTERFACE



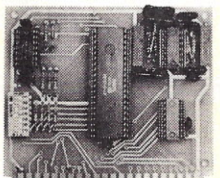
Part no. 600
• Converts RS-232 to 20mA current loop, and 20mA current loop to RS-232 • Two separate circuits • Requires +12 and -12 volts • Board only $4.50, with parts $7.00

TAPE INTERFACE *



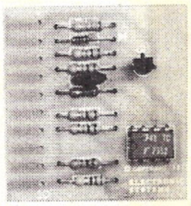
Part no. 111
• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board $7.60; with parts $27.50

UART & BAUD RATE GENERATOR *



Part no. 101
• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only $12.00; with parts $35.00 with connector add $3.00

RS 232/TTL* INTERFACE



Part no. 232
• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin gold plated edge connector • Board only $4.50; with parts $7.00 with connector add $2.00

ELECTRONIC SYSTEMS Dept. KB, P.O. Box 21638, San Jose, CA. USA 95151

To Order: Mention part number and description. For parts kits add "A" to part number. In USA, shipping paid for orders accompanied by check, money order, or Master Charge, BankAmericard, or VISA number, expiration date and signature. Shipping charges added to C.O.D. orders. California residents add 6.5% for tax. Outside USA add 10% for air mail postage, no C.O.D.'s. Checks and money orders must be payable in US dollars. Parts kits include sockets for all ICs, components, and circuit board. Documentation is included with all products. All items are in stock, and will be shipped the day order is received via first class mail. Prices are in US dollars. No open accounts. To eliminate tariff in Canada boxes are marked "Computer Parts." Dealer inquiries invited.
24 Hour Order Line: (408) 226-4064

✱ Circuits designed by John Bell

DIODES/ZENERS

1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N4733	5.1v	1 W Zener	.25
1N753A	6.2v	500 mW Zener	.25
1N758A	10v	"	.25
1N759A	12v	"	.25
1N5243	13v	"	.25
1N5244B	14v	"	.25
1N5245B	15v	"	.25

SOCKETS/BRIDGES

8-pin	pcb .20	ww	.35
14-pin	pcb .20	ww	.40
16-pin	pcb .20	ww	.40
18-pin	pcb .25	ww	.75
22-pin	pcb .35	ww	.95
24-pin	pcb .35	ww	.95
28-pin	pcb .45	ww	1.25
40-pin	pcb .50	ww	1.25
Molex pins	.01	To-3 Sockets	.25
2 Amp Bridge		100-prv	.95
25 Amp Bridge		200-prv	1.95

TRANSISTORS, LEDS, etc.

2N2222	NPN	(2N2222 Plastic .10)	.15
2N2907	PNP		.15
2N3906	PNP	(Plastic - Unmarked)	.10
2N3904	NPN	(Plastic - Unmarked)	.10
2N3054	NPN		.35
2N3055	NPN	15A 60v	.50
T1P125	PNP	Darlington	.35
LED Green, Red, Clear, Yellow			.15
D.L.747	7 seg 5/8" High com-anode		1.95
MAN72	7 seg com-anode (Red)		1.25
MAN3610	7 seg com-anode (Orange)		1.25
MAN82A	7 seg com-anode (Yellow)		1.25
MAN74A	7 seg com-cathode (Red)		1.50
FND359	7 seg com-cathode (Red)		1.25

C MOS

4000	.15
4001	.15
4002	.20
4004	3.95
4006	.95
4007	.20
4008	.75
4009	.35
4010	.35
4011	.20
4012	.20
4013	.40
4014	.75
4015	.75
4016	.35
4017	.75
4018	.75
4019	.35
4020	.85
4021	.75
4022	.75
4023	.20
4024	.75
4025	.20
4026	1.95
4027	.35
4028	.75
4030	.35
4033	1.50
4034	2.45
4035	.75
4040	.75
4041	.69
4042	.65
4043	.50
4044	.65
4046	1.25
4049	.45
4050	.45
4066	.55
4069/74C04	.25
4071	.25
4081	.30
4082	.30
MC 14409	14.50
MC 14419	4.85
4511	.95
74C151	1.90

– T T L –

7400	.10	7473	.25	74176	.85	74H72	.35	74S133	.40
7401	.15	7474	.30	74180	.55	74H101	.75	74S140	.55
7402	.15	7475	.35	74181	2.25	74H103	.55	74S151	.30
7403	.15	7476	.40	74182	.75	74H106	.95	74S153	.35
7404	.10	7480	.55	74190	1.25			74S157	.75
7405	.25	7481	.75	74191	.95	74L00	.25	74S158	.30
7406	.25	7483	.75	74192	.75	74L02	.20	74S194	1.05
7407	.55	7485	.55	74193	.85	74L03	.25	74S257 (8123)	1.05
7408	.15	7486	.25	74194	.95	74L04	.30		
7409	.15	7489	1.05	74195	.95	74L10	.20	74LS00	.20
7410	.15	7490	.45	74196	.95	74L20	.35	74LS01	.20
7411	.25	7491	.70	74197	.95	74L30	.45	74LS02	.20
7412	.25	7492	.45	74198	1.45	74L47	1.95	74LS04	.20
7413	.25	7493	.35	74221	1.00	74L51	.45	74LS05	.25
7414	.75	7494	.75	74367	.75	74L55	.65	74LS08	.25
7416	.25	7495	.60			74L72	.45	74LS09	.25
7417	.40	7496	.80	75108A	.35	74L73	.40	74LS10	.25
7420	.15	74100	1.15	75491	.50	74L74	.45	74LS11	.25
7426	.25	74107	.25	75492	.50	74L75	.55	74LS20	.20
7427	.25	74121	.35			74L93	.55	74LS21	.25
7430	.15	74122	.55			74L123	.85	74LS22	.25
7432	.20	74123	.35	74H00	.15			74LS32	.25
7437	.20	74125	.45	74H01	.20	74S00	.35	74LS37	.25
7438	.20	74126	.35	74H04	.20	74S02	.35	74LS38	.35
7440	.20	74132	.75	74H05	.20	74S03	.25	74LS40	.30
7441	1.15	74141	.90	74H08	.35	74S04	.25	74LS42	.65
7442	.45	74150	.85	74H10	.35	74S05	.35	74LS51	.35
7443	.45	74151	.65	74H11	.25	74S08	.35	74LS74	.35
7444	.45	74153	.75	74H15	.45	74S10	.35	74LS86	.35
7445	.65	74154	.95	74H20	.25	74S11	.35	74LS90	.55
7446	.70	74156	.70	74H21	.25	74S20	.25	74LS93	.55
7447	.70	74157	.65	74H22	.40	74S40	.20	74LS107	.40
7448	.50	74161	.55	74H30	.20	74S50	.20	74LS123	1.00
7450	.25	74163	.85	74H40	.25	74S51	.25	74LS151	.75
7451	.25	74164	.60	74H50	.25	74S64	.15	74LS153	.75
7453	.20	74165	1.10	74H51	.25	74S74	.35	74LS157	.75
7454	.25	74166	1.25	74H52	.15	74S112	.60	74LS164	1.00
7460	.40	74175	.80	74H53J	.25	74S114	.65	74LS193	.95
7470	.45			74H55	.20			74LS367	.75
7472	.40							74LS368	.65

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MCT2	.95	LM320T5	1.65	LM340K15	1.25	LM723	.40
8038	3.95	LM320T12	1.65	LM340K18	1.25	LM725N	2.50
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LM301	.45	LM324N	1.25	78L05	.75	LM741 (8-14)	.25
LM308 (Mini)	.95	LM339	.75	78L12	.75	LM747	1.10
LM309H	.65	7805 (340T5)	.95	78L15	.75	LM1307	1.25
LM309K (340K-5)	.85	LM340T12	.95	78M05	.75	LM1458	.65
LM310	.85	LM340T15	.95	LM373	2.95	LM3900	.50
LM311D (Mini)	.75	LM340T18	.95	LM380 (8-14 PIN)	.95	LM75451	.65
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LM320K12	1.65					NE565	.95
						NE566	1.25
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9301	.85	95H03	1.10
9309	.35	9601	.20
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Hazeltine 1400

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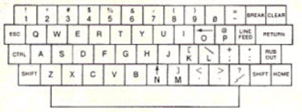
CRT TERMINAL

$659 plus shipping

The Hazeltine 1400 Vidio Display Terminal is designed to optimize interactive real-time operations. The interface is capable of either local or remote connection through an EIA RS232-C interface at baud rates that are switch selectable up to 9600 baud.

- All 128 ASCII Codes
- 64 Displayable Characters
- 24 Lines; 12 inch Screen
- 80 Characters per Line
- Self Diagnostic Test



Quantity pricing upon request.

S-100 Mother Board

Quiet Buss™ **$29.95** 18 slot IMSAI

The Quiet Buss from California Industrial is quality engineered. No short cuts have been taken to produce this mother board. Active termination circuitry prevents noise and crosstalk. Manufactured from extra heavy FR-4 epoxy glass.

TELETYPE® MODEL 43

New from Teletype, the Model 43 is capable of printing 132 ASCII characters per line. Send and receive data at 10 or 30 char. per second. Keyboard generates all 128 ASCII code combinations. RS-232 interface, same as the popular Model 33. Data sheet sent upon request. Manufacturer suggested price $1377.00.

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TTL model with NOVATION brand Acoustic Modem. $1419

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Maxi-Switch hexadecimal keyboards are designed for microcomputer systems that require 4-bit output in standard hex code.

Each assembly consists of 16 hermetically sealed reed switches and TTL "one shot" debounce circuitry.

Reliable low friction acetal resin plungers are credited for the smooth operation and long life of this premium keyboard.

Requires single +5 volt supply.

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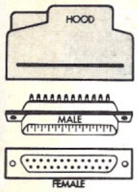
Definitely the best small system keyboard that we have seen. Maxi-Switch has incorporated all the important keyboard features at a reasonable price. Full 128 ASCII functions, "N" key rollover, automatic repeats, user designated special function keys, escape, control & lots of others. Data sheet upon request.

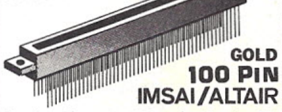
CONNECTORS

your choice DB25P male plug & hood or DB25S female **$3.95**



Qty.	fe.	male	hd.
10	3.45	2.45	1.15
25	3.15	2.25	1.05
100	2.85	1.90	.95
500	2.25	1.60	.85
1K	1.97	1.37	.73

Edge Connectors



GOLD 100 PIN IMSAI/ALTAIR

Imsai solder .125x.250	$4.95	3/$11.95
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22/44 Kim eyelet.156"	$1.95	3/$5.00
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SPERRY UNIVAC KEYBOARD

$24.88

The famous Sperry Univac 1710 Hollerith keyboard assembly is now available from California Industrial for only $24.88 The ideal computer input device for accountants and mathematicians. The numeric keys are placed on the lower three rows to resemble a ten key adding machine. This format allows one handed numeric data entry. Original cost was $385. Used but guaranteed in excellent condition. Complete with documentation.

FROM ATARI COLOR TELEVISION R.F. MODULATOR

$13.95

Assembled

The Atari R.F. Modulator allows computer data to be displayed directly upon your existing television system. This unit converts the signal from the Apple II and other video sources into television frequencies. Operates from single 5 volt supply. Complete with metal case, mating R.F. connector and 15 feet of coax cable. Schematics and instructions included.

SPECIAL APPLE II

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COLOR • GRAPHICS • SOUND

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8 inch Soft (IBM)
8 inch 32 sector
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This joystick feature four 100K potentiometers, that vary resistance proportional to the angle of the stick. Perfect for television games, quad stereo and radio controlled aircraft.

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Time 1 second to 10 hours

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GP100-Maximum design versatility along with standard address decoding and buffering for S100 systems. Room for 32 uncommitted 16 pin IC's, 5 bus buffer & decoding chips, 1 DIP address select switch, a 5 volt regulator and more.

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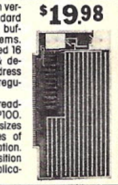

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Access time guaranteed faster than 450nS. **Minimum purchase 32 pieces.**

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74100	1.19
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74123	.69
74125	.59
74126	.59
74128	.49
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74136	.89
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74145	.99
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74151	.99
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74154	.99
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74156	1.29
74157	.99
74159	2.99
74160	[illegible]
74161	

4033	1.99
4035	1.69
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4041	1.49
4042	1.49
4043	1.49
4044	1.49
4046	2.49
4047	2.49
4049	.79
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Leads fan out to fit Mini-DIP socket.

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7402	[illegible]
7403	
7403	
7404	
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7406	
7407	
7408	
7409	
7410	
7411	
7412	[illegible]
7413	.49
7414	.79
7416	.39
7417	.39
7420	.19
7422	.49
7423	.39
7425	.39
7426	.39
7427	.39
7428	.49
7429	.39
7430	.25
7433	.39
7437	.39
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[illegible]	.39
[illegible]	.39
[illegible]	.79
[illegible]	.39
[illegible]	.39
[illegible]	.55
[illegible]	.55
[illegible]	3.49
[illegible]	1.49
[illegible]	.99
[illegible]	1.19
[illegible]	.09
[illegible]	.79
[illegible]	.39
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340T-5, 340T-12

UART AY 5-1013A **$4.98**

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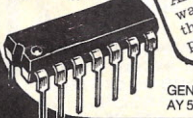
Since the inception of our organization in 1968, we have strived to offer our customers the highest quality electronic and industrial products at competitively low prices. In the past several years our focus has narrowed to primarily computer and digital related products. Appropriately the name CALIFORNIA DIGITAL evolved.

All of us at California Digital want to take this opportunity to thank you for your continued patronage.



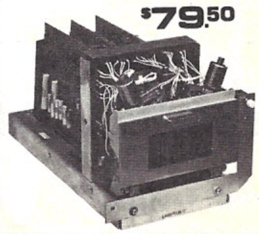
SPECIAL

GENERAL INSTRUMENT ASCII Keyboard Encoder AY 5-3600 Prime but house marked only $4.95

Digital Cassette Drive

COMPUTER CONTROLED

$79.50



This precision I/O assembly features remote software controlled search capabilities. Two independent capstan drive motors allow the computer to control direction and speed of the transport.

The assembly consists of a Raymond cassette transport, chassis, motherboard and three edge cards: read/write, capstan drive & control card.

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Ten position BCD

$1.39 ea.

10	50
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MINIATURE SWITCHES

your choice **$.98**

10	50	100	1k
$.88	.81	.73	.66

SPDT Miniature Toggles

7101	C&K	ON-NONE-ON
7107	jbt	ON-OFF(mnt.ON)
7108	CK	ON-(moment. ON)
Rocker	JBT	DPDT
Rotary		3P-4-Pos.
Rotary		3P-6-Pos.
Push B (N.O.)		$.39ea. 4/$1

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80,000/10v.	3.95	3.49	2.95
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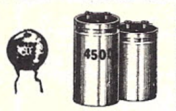
1000/15v axial	$.55	.49	.45
.1 disc	$.12	.09	.07
.01 disc	.06	.05	.04



DIP Switch

$1.49 ea.

10	25	100	1k
$.29	1.15	.97	.85

specify 7 or 8 pos.

SPST CTS

50 Conductor $.69 Ft. RIBBON WIRE

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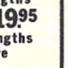

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KIT No. 1 $6.95 900 Assorted Lengths

KIT No. 2 $19.95 2800 Assorted Lengths 250' Bulk Wire

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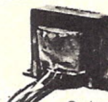
2N2222A	.20	.18	.16	.15
2N3055	.69	.65	.59	.55
MJ3055	.79	.75	.69	.65
2N3772	1.59	1.49	1.39	1.29
2N3904	.15	.11	.09	.07
2N3906	.15	.11	.09	.07

Diodes

		10	25	100
1N4002	100v.	.08	06	.05
1N4005	600v.	.10	.08	.07
1N4148	signal	.07	.05	.04

jumbo red LED's

ea.	10	25	100
$.15	.13	.11	.09



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Heavy duty grounded power cord and mating chassis connectors.

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16¢	14¢	12¢

PANASONIC $.98

Nicad "AA" 450mA.

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8	—			17¢	16	15
14	37¢	36	35	18	17	16
16	38	37	36	19	18	17
24	99	93	85	36	35	34
40	169	155	139	63	60	58

Battery wire wrapping tool ~~$34.95~~ **$29.95** BW630

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500	1,000	11,000
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EXPANDABLE EPROM BOARD

16K OR 32K EPROM $49.95 W/OUT EPROM

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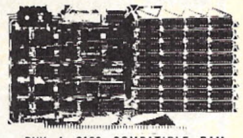
THE ULTIMATE RAM BOARD
32K FOR $475.00



32K MODEL

8K	$151.00
16K	259.00
24K	367.00
32K	475.00

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32K	519.00
48K	757.00
64K	995.00

THE 32K VERSION USES THE MOSTEK MK4115 RAM AND HAS 8K BOUNDARIES AND PROTECTION & UTILIZES DIP SWITCHES. P. C. BOARD COMES WITH SOCKETS FOR 32K OPERATION

BUY A S100 COMPATIBLE RAM BOARD AND UPGRADE THE SAME BOARD TO A MAXIMUM OF 65K MEMORY IN STEPS OF EITHER 8K OR 16K AT YOUR OPTION BY MERELY PURCHASING MORE RAM CHIPS FROM SD COMPUTER PRODUCTS.

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LOOK AT THE FEATURES WE HAVE BUILT INTO THE EXPANDORAM!

- MEMORY ACCESS TIME IS 375 ns
- MEMORY CYCLE TIME IS 500 ns
- POWER REQUIREMENTS ARE:
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  18 VDC 400 MA DC
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- ON BOARD INVISIBLE REFRESH
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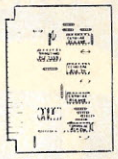
- DESIGNED TO WORK WITH Z-80, 8080, 8085, CPU's

ADD $50.00 TO ABOVE PRICES FOR FULLY ASSEMBLED AND TESTED BOARDS

Low Cost Cassette Interface Kit

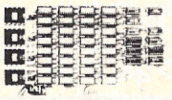
$19.95



Features: Play and record K.C. Standard 2400/1200 Hz tapes, 300 Baud, TTL I/O Compatible, Phase Lock Loop, Both 22 Pin Connector and 8 Pin Molex Connector. Comes partially assembled. Oscillator and phase lock loop pre-tuned to K.C. Standard. Selector switch sends cassette data or auxiliary input data to microprocessor. LED indicates logic 1 level.

4K LOW POWER RAM KIT
The Whole Works - $79.95

Full Buffered - on board regulated - reduced power consumption utilizing low power 21L02-1 500ns RAMS - Sockets provided for all IC's. Quality plated through PC board.



*Add $10.00 for 250ns RAM operation.

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$159.95

FULLY ASSEMBLED AND TESTED. NOT A KIT.

Imsai — Altair — S-100 Buss compatible, uses low power static 21L02-500ns fully buffered on board regulated, quality plated through PC board, including solder mask. 8 pos. dip switches for address select.

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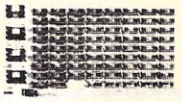
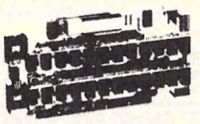


Z-80 CPU BOARD KIT
Complete Kit $139.

CHECK THE ADVANCED FEATURES OF OUR Z-80 CPU BOARD: Expanded set of 158 instructions, 8080A software capability, operation from a single 5VDC power supply; always stops on an M1 state, true sync generated on card (a real plus feature!), dynamic refresh and NMI available, either 2MHZ or 4MHZ operation, quality double sided plated through PC board; parts plus sockets provided for all IC's. *Add $10. extra for Z-80A chip which allows 4MHZ operation.



NEW FROM S.D.
"VERSAFLOPPY"™ KIT

THE VERSATILE FLOPPY DISK CONTROLLER

ONLY $149.00

FEATURES: IBM 3740 Soft Sectored Compatible. S-100 BUS Compatible for Z-80 or 8080. Controls up to 4 Drives (single or double sided). Directly controls the following drives:

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3. PERSCI 70 and 277.
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FD 1771B-1 CHIP ALONE $39.95

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Complete Kit includes: Key board and Display; Z80 Central Processing Unit; Instructions; Operation Manual; Learning Guides.

Features: Powerful Z80 CPU with 158 instructions • 1024 Bytes (Expandable to 2048 Bytes ON BOARD) of RAM • 2 Bi-Directional Input/Output Ports with Handshaking • Kansas City Standard Audio Cassette Interface for Program Storage • Hexadecimal Keyboard and Display • Wirewrap area for custom circuitry • S-100 Connector on board for Memory and I/O Expansion • 2716/2758 PROM Programmer • "Z-BUG" Monitor ROM (Including: Memory, Port and Register Examine and Change Commands; Breakpoints; Single Step Capability; Audio Tape Load and Dump; Execute user program Commands.)

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(The Z-80 Based, S-100 Single Board Computer)

$349.00

FEATURES:

- No Front Panel Needed
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- 4 ROM/PROM Sockets for 4K/8K of Memory
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- Programmable Baud Rate
- Parallel Input Port
- Parallel Output Port
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ORDER ALL 3 KITS TOGETHER FOR

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This Powerful Threesome Operates Together to Form A Complete Computer for Your System.

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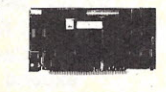

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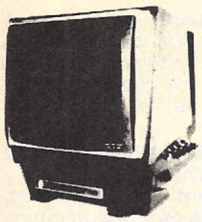

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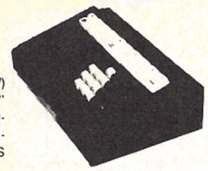

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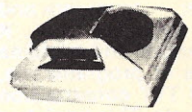

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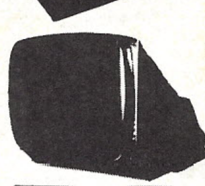

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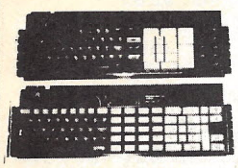

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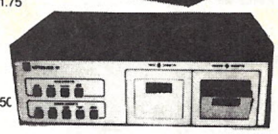

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+5	20.0	RTL	B316	$95	+90	1.0	XN	5154	$14
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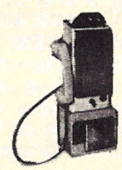

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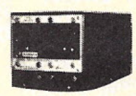

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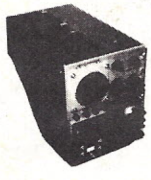

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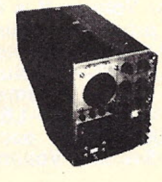

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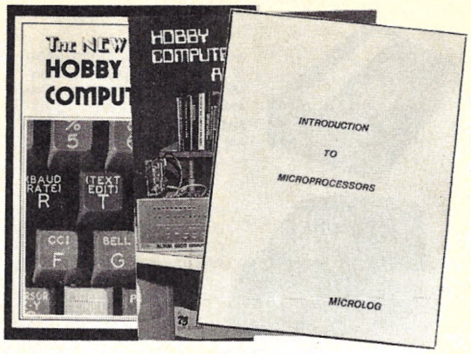

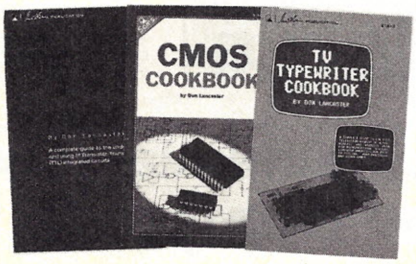

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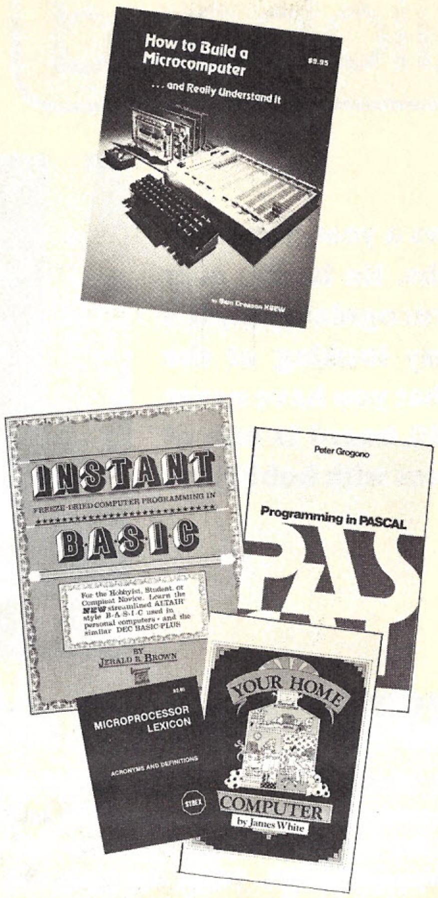

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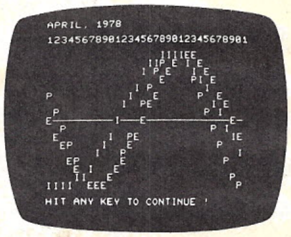

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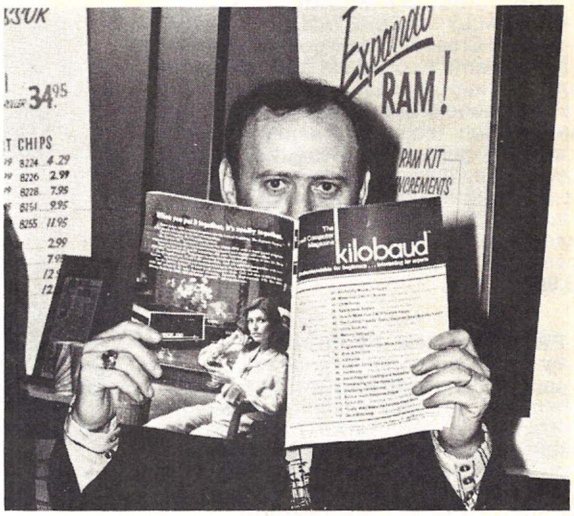

If there are 29 computer shows a year, this chap will find 30 to take his booths. He hardly ever misses a show. If you don't recognize him, it's because you've been so busy looking at the bargains he brings to shows that you have never looked up. A hint . . . his Z-80 board is one of the most popular in the business with hobbyists. Got it?

LAST MONTH'S MYSTERY READER

The clown behind the KILOBAUD last month is a professional. He's Peanuts, the Magic Clown, and he entertained at the Godbout booth during the San Jose show. He is also the designer of the incredibly popular Econoram boards. When not designing state-of-the-art boards, Peanuts is busy with magic and making animals out of balloons.
Behind the clown mask is mild-mannered Bruce Mycroft of the Daily Planet, who can leap small circuit boards in a bound.

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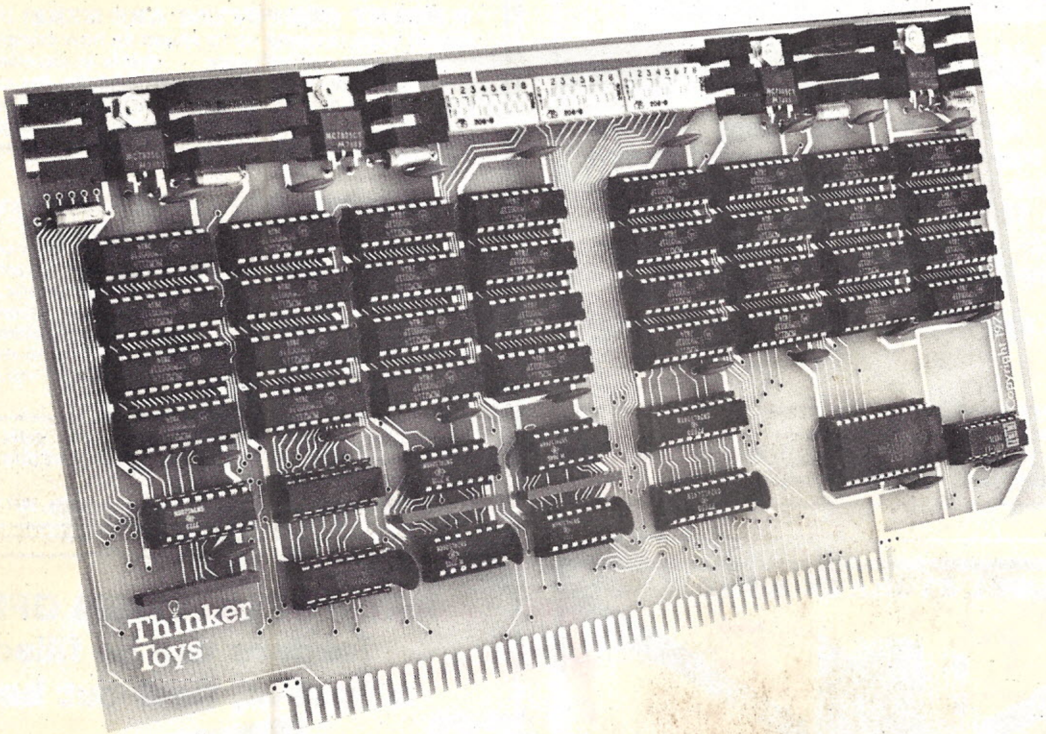

Introducing SuperRam™ 16K static memory, the one that's leaping tall price barriers at a single bound. It saves you about $100 on the usual cost of a big 16K memory for your S-100 system.

SuperRam™ 16K is the latest in cost-efficient memory designs by George Morrow, designer of the best-selling ECONORAM* memories.

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The OSI 48 Line BUS

OHIO SCIENTIFIC offers the broadest line of BUS compatible microcomputer boards. This line includes several new and exciting products which are not available anywhere else, such as a three processor CPU board, dual port memories and a multiprocessing CPU expander.

OHIO SCIENTIFIC has delivered approximately 100,000 boards based on our 48 line BUS and is now delivering thousands per week in 17 models of computers and dozens of accessories.

OHIO SCIENTIFIC'S BUS design incorporates high band width, high density and mass production technology to achieve a truly remarkable performance to cost ratio.

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Product Description	Special Features	Power Supply Voltages Req'd	Board & Doc. Part #	Board & Doc. Price	Assembled Product Part #	Assembled Product Price
CPU						
• Challenger II CPU BASIC-in-ROM 6502 based CPU with serial I/O 4K RAM, machine code monitor	• Can use four 2716 EPROMS instead of BASIC or can be configured for disk	+5/−9	500	39.00	C2-0	298.00
• Challenger III CPU has 6502A, 6800 and Z80 micros, RS-232 serial port, machine code monitor	• 1 megabyte memory manager, software programmable vectors	+5/−9	510	NA	C3-0	490.00
• 560Z multi-processing CPU expander runs PDP-8, Z80 and 8080 code	• Runs concurrently with another OSI CPU	+5/−9	560Z	125.00	NA	NA
RAM						
• 16K static RAM (Ultra low power)	• 215NS access time automatic power down standby mode	+5/+12/−9	520	35.00	CM-3	498.00
• 8K static RAM (low cost)	• Expandable to 16K	+5	—	—	CM-7	198.00
• 16K static RAM (low cost)	• Can be expanded to dual port operation	+5	525	35.00	CM-8	339.00
• 24K static RAM (high density)	• 20 address bits	+5	527	35.00	CM-9	NA
• 4K static RAM (2102 based)	• Can be populated for 4K by 12 bits	+5	420	35.00	CM-2	125.00
• 16K dynamic (ultra low cost)	• Uses 4027 RAMS	+5/+12/−9	530	NA	CM-4	249.00
• 32K dynamic	• 20 address bits	+5/+12/−9	530	NA	CM-5	698.00
• 48K dynamic (high density)	• 20 address bits	+5/+12/−9	530	NA	CM-6	990.00
EPROM Boards						
• 8K 6834 EPROM board	• 16 line parallel port and on board programmer	+5/−9	450	35.00	NA	NA
• 4K 1702A EPROM board	• 16 line parallel port	+5/−9	455	35.00	NA	NA
I/O Boards						
• Audio Cassette interface Kansas City standard 300 baud	• Expandable to CA-7C	+5/−9	430	35.00	CA-6C	99.00
• RS-232 port board	• Expandable to CA-7S	+5/−9	430	35.00	CA-6S	99.00
• Combination audio cassette two 8 bit DACs, one fast A/D and 8 channel input mux	• Also Features 8 parallel I/O lines	+5/−9	430	35.00	CA-7C	399.00
• Combination RS-232 two 8 bit DACs, one fast A/D and 8 channel input mux	• Also features 8 parallel I/O lines	+5/−9	430	35.00	CA-7S	399.00
• 32 by 32 character video display interface	• Keyboard input port	+5/−9	440	35.00	NA	NA
• 32 by 64 character video display interface	• Upper/lower case graphics and keyboard port	+5	540	NA	CA-11	249.00
• 16 port serial board RS-232 and/or high speed synchronous	• 75 to 19,200 baud and 250K and 500K bit rates individually strappable	+5/−9	550	35.00	CA-10X	200.00 to 900.00
• Parallel (Centronics) Line Printer Interface	• With cable	+5/−9	470	NA	CA-9	249.00
• 96 Line Remote Parallel Interface	• Interface "Front End" remotable via 16 pin ribbon cable	+5	—	—	CA-12	249.00
• Voice I/O board with Votrax* module	• Fully assembled voice output, experimental voice input	+5/−9	—	—	CA-14	525.00
DISKS						
• Single 8" floppy disk, 250 Kbytes storage	• Complete with operating system software and disk BASIC	+5/−9	470	NA	CD-1P	790.00
• Dual 8" floppy disk, 500 Kbytes storage	• Complete with operating system software and disk BASIC	+5/−9	470	NA	CD-2P	1390.00
• 74 Million byte Winchester disk and interface	• Complete with OS-65U operating system	+5/−9	—	—	CD-74	6000.00
OTHER						
• 8 slot backplane board with connectors	• Can be daisy-chained to n-slots	—	580	39.00	NA	NA
• Prototyping board	• Handles over 40 16 pin IC's	—	495	29.00	—	—
• Card Extender	• With connectors	—	498	29.00	—	—

For more information, contact your local OHIO SCIENTIFIC Dealer or the factory at (216) 562-3101

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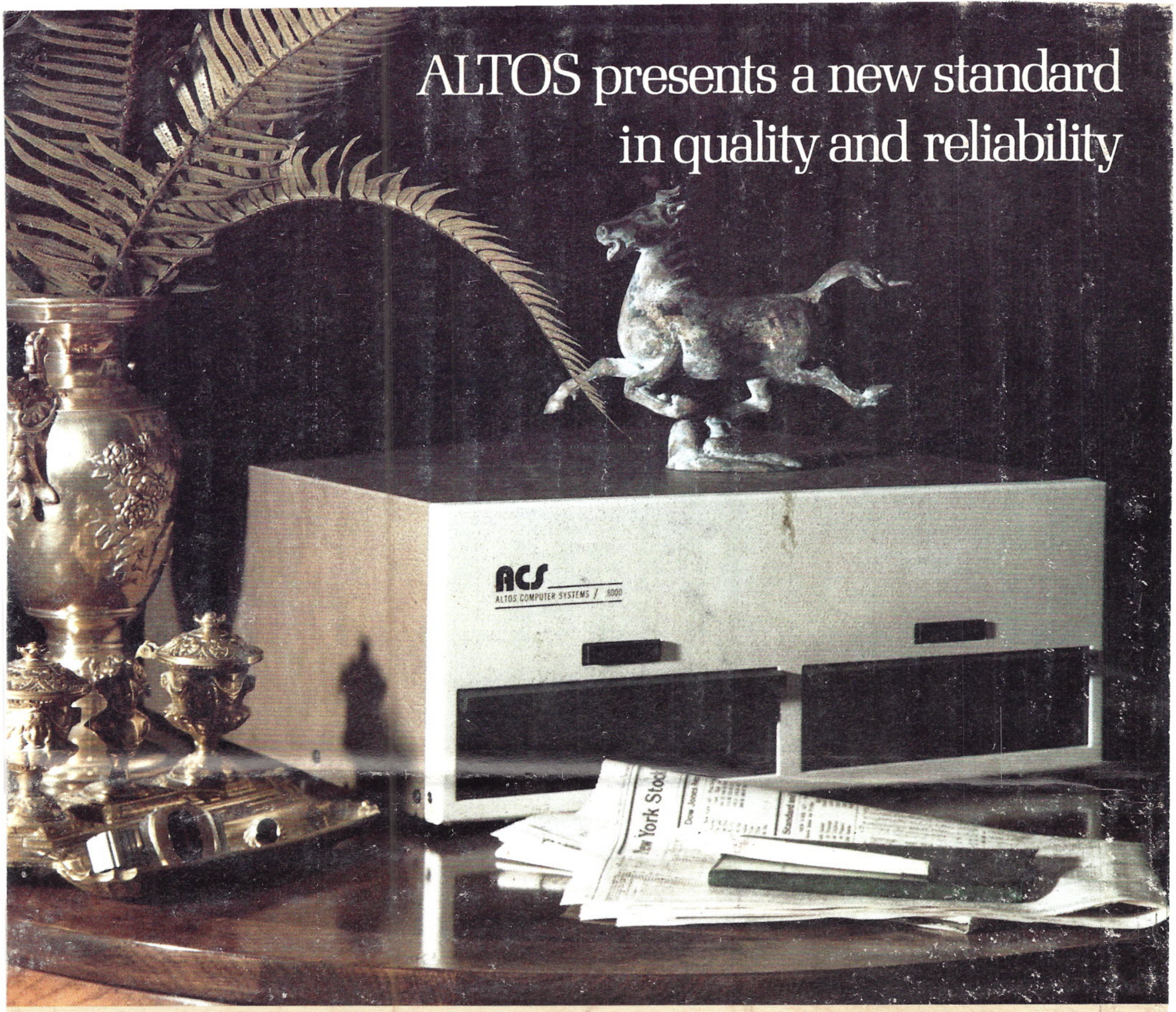

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